Who Measures Long-Term Liabilities? Actuaries and Public Pension Finance

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Abstract

Institutions routinely delegate complex measurement to external experts, creating scope for expert judgment and discretion to shape reported information. This paper studies delegated measurement in state and local public pensions, where actuaries value long-term benefit promises that determine reported funding, required contributions, and fiscal risk. I use novel data linking plan-level financials to actuarial firms and valuation assumptions. Leveraging actuarial firm switches and malpractice litigation, I show that actuaries materially affect reported liabilities and funding status. Small actuarial firms, in particular, are associated with more favorable reporting. When an actuarial firm is sued for malpractice, its other public pension clients subsequently report stronger financials and use more aggressive assumptions, consistent with reputational and market incentives shaping expert discretion. Counterfactual exercises suggest that these forces shift aggregate reported liabilities by tens to hundreds of billions of dollars.

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1. Introduction

Institutions routinely delegate the measurement, certification, and interpretation of complex economic objects to external experts. Credit rating agencies assess default risk, investment consultants evaluate asset managers, actuaries value pension promises and insurance reserves, engineers and environmental consultants assess remediation and decommissioning costs, and auditors attest to financial statements. In principle, these experts bring specialized knowledge and independent assessment that can constrain discretion. In practice, however, expert measurement is not purely mechanical. Experts exercise judgment in selecting assumptions, applying models, and implementing standards, and their assessments may reflect the incentives and institutional features of the markets in which they operate.

Actuaries and public defined benefit pensions provide a fundamental setting to study this discretion. Actuaries advise on and implement the assumptions and methods used to value projected benefits and translate those valuations into reported liabilities and required contributions. The fiscal stakes are enormous. With trillions of dollars in promised benefits at play, even modest changes in actuarial assumptions or methods can materially shift measured liabilities and contribution requirements. This matters because defined benefit pension plans are fundamentally liability-driven institutions: the measured liability is the anchor around which contribution requirements, investment policy, and benefit sustainability assessments all revolve. Mismeasurement of the liability could therefore propagate through the entire governance chain. Yet systematic evidence on the role actuaries play in selecting and operationalizing these inputs remains limited (Bagchi and Naughton, 2021), despite recurring controversies and litigation (e.g., The New York Times, 2008).

This paper asks whether the experts who perform delegated measurement affect the financials that institutions report. I study this question in the market for U.S. state and local public pension actuarial services. First, holding plan fundamentals fixed, are some actuarial firms systematically associated with more or less favorable measures of pension finances? Second, do shocks to an actuarial firm's reputation or incentives change the reported financials of other plans that employ the same firm? These questions speak not only to public pensions, but also to a broader class of settings in which institutions rely on specialized experts to measure long-duration obligations.

I use the Boston College Public Plans Database (PPD), which compiles plan–year actuarial information reported in public pension financial disclosures, including funded status, actuarial liabilities and assets, selected actuarial assumptions, and, in many cases, the name of the actuarial firm. I expand and correct the PPD's coverage by consulting actuarial valuation reports and Comprehensive Annual Financial Reports (CAFRs) to fill in missing entries and fix apparent errors. The resulting panel covers more than 200 major state and local defined benefit plans between 2001 and 2022, representing about 95 percent of public pension assets and membership. For each plan–year, I observe actuarial liabilities, the actuarial value of assets, the funded ratio, plan membership, average wages and benefits, market value of assets, actuarial assumptions, and the identity of the actuarial firm.[1]

The first part of the paper provides institutional background and descriptive evidence on the market for public pension actuarial services. I document a clear distinction between a small set of large actuarial firms that serve dozens of plans across many states and a long tail of smaller "boutique" firms that focus on one or a few plans within a state or region. A handful of large firms account for a disproportionate share of plan–years and liabilities. In addition, some of the largest plans rely on internal actuarial staff rather than external consulting firms.[2] Actuarial relationships are persistent: it is common for a plan to retain the same actuary for a decade or more, although there are still several switches during the sample period.

The second part of the paper estimates a series of two-way fixed effects models *à la* Abowd et al. (1999) that decompose reported pension outcomes into plan effects, year effects, and actuarial firm effects. Using identifying variation from plans that switch actuarial firms, I recover actuarial firm fixed effects for multiple outcomes (funded ratios, actuarial liabilities, actuarial assets, required contributions, and key assumptions) and summarize the implied cross-firm heterogeneity with the empirical distribution of estimated firm effects and AKM variance decompositions.[3]

The results show substantial and systematic dispersion in actuarial firm effects across outcomes: the estimated firm effects span a wide range for funded ratios, liabilities, and actuarial assets, implying that the identity of the actuary is associated with economically meaningful differences in reported financial condition. Consistent with this, adding actuarial firm fixed effects materially raises within-plan explanatory power relative to a baseline with plan and year fixed effects and fundamentals, and the AKM decompositions indicate that firm effects account for a nontrivial share of within-plan variation (alongside common time shocks and persistent plan heterogeneity). Importantly, these firm effects line up across outcomes in

[1] The actuarial value of assets differs from market value because it typically incorporates smoothing methods that recognize investment gains and losses over multiple years; in contrast, market value reflects contemporaneous prices.

[2] I classify a plan as using internal actuarial services when the valuation is produced by an in-house actuarial office or staff actuary rather than an external consulting firm; some plans may still retain external consultants for specialized tasks, such as experience studies or peer review.

[3] As in Abowd et al. (1999), point identification of firm effects relies on mobility that links firms and plans within a connected set. I estimate and interpret firm effects on the largest connected component; results that only require indicator variation, such as descriptive or event-study exercises, may use the full sample, including firms that appear in isolated components.

economically sensible ways: actuaries associated with higher reported funding are also more likely to adopt assumptions that mechanically raise reported funded status, such as higher (more aggressive) discount rates, implying that cross-firm heterogeneity reflects coherent reporting styles rather than noise. These differences in valuation practices also translate into variation in required contributions, indicating that actuarial discretion affects the fiscal benchmarks facing plan sponsors.

I then turn to dynamic evidence from actuary switches. Using a stacked event-study design (Cengiz et al., 2019), I examine how reported financials evolve around the year in which a plan changes actuarial firms. On average, switches are not associated with large immediate changes in reported financials. However, the results differ sharply by switch type. Transitions between small "boutique" firms are followed by significant improvements in funded ratios, driven by lower reported liabilities, and by lower required contributions. This heterogeneity is consistent with a market in which some plans can obtain more favorable reported financials by changing the expert who implements the valuation.

Finally, I study how actuarial firms respond to reputational shocks due to litigation. I leverage seven high-profile lawsuits for actuarial malpractice brought against seven actuarial firms between 2005 and 2021. Most cases involve allegations that actuaries understated liabilities or otherwise misrepresented financial positions, although one involves a non-pension actuarial dispute. I construct a sample of plans that employ the sued actuary but were not plaintiffs themselves and estimate stacked event-study regressions around the lawsuit year.

Following a lawsuit, other clients of the sued actuarial firm report stronger financials: funded ratios increase, reported actuarial liabilities fall, and assumptions become more aggressive, especially through higher discount rates. These effects emerge after the lawsuit and are absent in the pre-period. This pattern is difficult to reconcile with a view of actuaries as purely mechanical implementers of board-approved assumptions. Instead, it suggests that actuaries help frame the financial picture that plans present and that both clients and actuaries respond strategically to shocks in the environment.

I conclude the paper with a discussion of the aggregate implications of these findings. Using the estimated actuarial firm effects, I simulate how total reported actuarial liabilities would change if all plans were reassigned to a common actuarial firm drawn from a given percentile of the firm-effect distribution (similar to Chetty et al., 2014b; Lyubich, 2025). Reassigning all plans to the 75th- or 90th-percentile firm would raise aggregate reported liabilities in 2022 by approximately $134 billion (2.1 percent) or $552 billion (8.8 percent), respectively. A separate counterfactual removes the post-lawsuit leniency effect from plans served by sued actuaries, implying that reported liabilities are lower by roughly $50 billion relative to a no-lawsuit-leniency benchmark. Together, these exercises suggest that actuarial practice heterogeneity and incentive distortions are large enough to shift aggregate reported liabilities by tens to hundreds of billions of dollars, meaningfully affecting the fiscal picture of public pension underfunding.

This paper contributes first to the economics of delegated expertise, certification, and expert intermediaries. A large literature studies when principals rely on better-informed but potentially biased experts, emphasizing tradeoffs between expertise, communication frictions, incentives, and loss of control (e.g., Crawford and Sobel, 1982; Aghion and Tirole, 1997; Dessein, 2002; Pesendorfer and Wolinsky, 2003). Related work studies credence goods, delegated finance, and expert intermediaries, showing that specialized experts can reduce information frictions while introducing agency problems of their own (Dulleck and Kerschbamer, 2006; Stoughton, 1993; Gennaioli et al., 2015). I add to this literature by studying delegated measurement: actuaries do not merely recommend actions or certify an existing object, but help produce the liability measures that become inputs into public reporting, contribution policy, and pension governance. The paper provides direct evidence that the identity and incentives of the external expert affect measured financial outcomes, even after controlling for plan fundamentals and common shocks.

Second, the paper contributes to the literature on state and local public pension liabilities and fiscal risk. A large body of work documents the size and distribution of unfunded liabilities, the sensitivity of reported funding to assumptions, and the implications for state and local finances (e.g., Brown and Wilcox, 2009; Novy-Marx and Rauh, 2009, 2011; Lenney et al., 2021; Giesecke and Rauh, 2023). I complement this work by shifting the focus from the choice of discounting rule to the experts who implement the valuation. Even holding plan fundamentals and accounting rules fixed, the identity of the actuary systematically affects reported funded ratios and liabilities. In this sense, I highlight a source of heterogeneity in pension reporting that operates through delegated measurement rather than through statutory rules or sponsor choices alone.

Third, the paper contributes to work on financial intermediaries, consultants, and reporting gatekeepers. Existing research has examined how credit rating agencies, auditors, sell-side analysts, municipal advisors, and investment consultants mediate between complex underlying risks and end-users, and how conflicts of interest, regulation, and market structure shape their behavior (e.g., Becker and Milbourn, 2011; Bolton et al., 2012; Opp et al., 2013; Xia, 2014; Frankel et al., 2002; Jenkinson et al., 2016; Garrett, 2024). I extend this literature by treating actuaries as measurement intermediaries on the liability side. In contrast to investment consultants, who advise on asset allocation and manager selection, public pension actuaries help determine the liability measure around which contribution policy, investment risk-taking, and sustainability assessments revolve.

Finally, the paper relates to work on public pension governance and institutional-investor behavior. A number of papers show that regulatory and accounting rules shape risk-taking: U.S. public plans invest more aggressively when liability discount rates are tied to expected returns and when plans are underfunded, relative to private and foreign funds (Andonov et al., 2017; Mohan and Zhang, 2014; Boon et al., 2018; Lu et al., 2019). Governance and board composition further influence asset allocation and the use of alternative investments (Andonov et al., 2018). I add to this view of public plans as strategic actors by focusing on the liability side, the measurement channel through which actuarial assumptions affect reported funding, contributions, and downstream governance decisions.

The remainder of the paper is organized as follows. Section 2 provides institutional background on public pension finance and actuarial practice. Section 3 describes the data and sample construction, and Section 4 presents descriptive evidence on the market for public pension actuaries. Section 5 develops the empirical strategy for studying actuarial firm effects on pension plan financials and reports the main results. Section 6 presents the empirical strategy and results for the analysis of actuarial malpractice lawsuits. Section 7 quantifies the aggregate implications of actuarial firm heterogeneity through a counterfactual exercise. Section 8 concludes.

2. Institutional Background

2.1 Public pension finances and actuarial valuations

State and local defined benefit plans promise future benefit streams to workers and retirees, typically as a function of years of service and final salary. To assess the fiscal position of these plans, policymakers and market participants rely on several key quantities: the actuarial accrued liability, the actuarial value of assets, the funded ratio (assets divided by liabilities), and the actuarially determined contribution (ADC), which reflects the contribution required in a given year to cover newly accrued benefits and to amortize unfunded liabilities.[4]

These quantities are constructed through an actuarial valuation. On the liability side, actuaries project future benefit payments under plan rules and demographic assumptions regarding retirement, termination, disability, and mortality (including assumed future improvements). They then discount these cash flows using a discount rate that is typically

[4] The terminology for the recommended contribution varies across time and reporting regimes (e.g., ARC under earlier GASB standards and ADC/ADEC in more recent usage). For consistency, I use "ADC" to refer to the actuary-recommended contribution in a given plan–year.

tied to the plan's long-run expected return on assets under prevailing accounting standards.[5] The choice of discount rate, mortality table, and associated improvement scale can materially affect the present value of liabilities.

On the asset side, plans maintain accounting values that smooth market fluctuations. The actuarial value of assets is typically constructed by smoothing realized gains and losses relative to expected returns over a period of years, subject to corridor constraints.[6] This smoothing affects both the reported funded ratio and the ADC, since the latter depends on the gap between actuarial assets and actuarial liabilities.

The ADC itself embeds additional modeling choices.[7] The normal cost reflects the cost of benefits earned during the year, but the amortization of unfunded liabilities depends on the chosen amortization period, method (level dollar vs. level percentage of payroll), and whether the amortization schedule is closed or open. Plans have discretion, within the bounds of accounting standards and board policies, over these modeling choices, and actuaries play a key role in proposing and implementing them. In this sense, the actuarial liability is the linchpin of defined benefit pension governance: it determines the funded ratio that boards monitor, the contributions that sponsors must make, and the surplus or shortfall that shapes investment strategy and benefit negotiations. Errors or discretion in liability measurement thus cascade through every major decision the plan faces.

2.2 Actuaries and public pension governance

Public pension actuaries are typically hired under multi-year contracts through public procurement processes. Boards or sponsoring governments issue requests for proposals (RFPs), and actuarial firms submit bids that detail their proposed services, experience, and fee structures. Winning firms enter into long-term relationships with plans, often with automatic renewals or occasional re-bidding. It is common for a plan to retain the same actuary for many years.

Once engaged, actuaries prepare the annual or biennial actuarial valuation reports. These reports describe plan membership, actuarial assumptions and methods, actuarial liabilities,

[5] Under prevailing public-sector accounting, the discount rate is generally linked to the long-run expected return on plan assets when projected assets are sufficient to cover benefit payments; if projected assets are insufficient, accounting rules call for a blended rate that uses a high-grade municipal bond index rate for the shortfall portion. In practice, most large plans report discount rates close to their assumed return.

[6] Many plans bound the actuarial value of assets within a corridor around market value (e.g., a fixed percentage band) to limit divergence between smoothed and market measures; corridor rules vary across plans and over time.

[7] Even holding benefit provisions fixed, reported normal cost and amortization payments depend on actuarial cost method, amortization basis, period, and payroll growth assumptions; these choices can change the time path of reported contributions without changing underlying promised benefits.

actuarial assets, and recommended contributions. They also conduct experience studies on a periodic basis (for example, every five years) to evaluate whether assumptions remain appropriate in light of observed demographic and economic experience. Actuaries propose changes to assumptions, which must be approved by the plan's board or other governing body.

Through this process, actuaries can influence reported financials in several ways. First, they can recommend discount rates and other economic assumptions within the range of what boards are willing to accept. Second, they can propose methods for smoothing asset gains and losses and for amortizing unfunded liabilities. Third, they can implement technical details in ways that affect the mapping between underlying economic conditions and financial reports. Although boards ultimately approve assumptions and methods, they rely on actuaries' expertise, and many board members lack the technical background to fully evaluate the implications of alternative choices.

The incentives facing actuaries are complex. On the one hand, professional standards and regulatory oversight encourage conservative and realistic valuation. On the other hand, actuaries are hired and can be replaced by clients; they compete in a market where plans may value more favorable reporting; and their reputations can be affected by both perceived conservatism and high-profile failures.[8] These features raise the possibility that actuaries may cater to client preferences or that some firms may develop reputations for providing more or less generous valuations.

A number of scandals and lawsuits have highlighted potential conflicts. Media reports have discussed cases in which actuaries were accused of understating liabilities or overstating funded ratios, thereby facilitating insufficient contributions and delaying necessary reforms.[9] Yet systematic evidence on the role of public pension actuaries remains scarce. Existing work on intermediaries in municipal finance focuses on auditors, municipal advisors, or credit rating agencies, and the literature on public pension reporting has largely emphasized assumptions chosen by boards rather than the role of external experts.[10]

[8] Public pension actuaries are generally bound by Actuarial Standards of Practice (ASOPs) and professional qualification standards, and are typically members of U.S. actuarial professional bodies; enforcement is largely professional/disciplinary rather than a prudential regulator in the banking sense.

[9] For example, see The New York Times (2008) for a journalistic discussion.

[10] See, for example, Naughton et al. (2015) and Bagchi and Naughton (2021) for related work on public pension disclosures and assumptions.

3. Data

The core of my empirical analysis uses the Public Plans Database (PPD), maintained by the Center for Retirement Research at Boston College. The PPD provides a harmonized panel of plan-level data for more than 200 major state and local defined benefit plans starting in 2001. For each plan–year, the PPD reports actuarial liabilities under the relevant accounting standards, the actuarial and market values of assets, the funded ratio, the actuarially determined contribution, benefits paid, and measures of plan membership (active workers, beneficiaries, and total members), among other variables.

I restrict the sample to traditional defined benefit plans (excluding defined contribution or hybrid arrangements) and to plans with at least 10 years of data.[11] This yields a panel that covers the vast majority of public pension assets and membership in the United States. The resulting sample includes both state-administered plans and large local systems in major cities and counties.

The PPD records the actuarial firm name and key assumptions (such as the discount rate and inflation) for most plan–years. I expand and correct this information by consulting actuarial valuation reports and Comprehensive Annual Financial Reports (CAFRs) to fill in missing entries and fix apparent errors in plan information. I also harmonize firm names over time to account for mergers and rebranding.[12] The resulting panel identifies the actuarial firm $a(i,t)$ that values plan i in year t, whether that firm is external or internal, and a cleaned series of actuarial assumptions. I also construct a measure of required contributions as a percentage of payroll by adding the employer's actuarially determined contribution rate and the employee normal cost rate. The employee normal cost rate is reported in the PPD for most plan–years; where missing, I fill in values from actuarial valuation reports and CAFRs. This combined measure captures the full contribution burden implied by the actuarial valuation, encompassing both the employer's required payment (which includes amortization of unfunded liabilities) and the employee's share of normal cost. The variable is not available for all plan-years because some plans, particularly agent and cost-sharing multiple-employer systems, do not report plan-level required contributions or payroll in the PPD, as these quantities are computed at the system level and may not be attributable to individual participating employers. Table 1 presents summary statistics.

[11] I exclude plans that are primarily defined contribution and plans with materially hybrid benefit structures when the PPD does not report a consistent DB liability series. Plans with minor hybrid elements are retained when the reported DB valuation measures remain comparable over time.

[12] I standardize firm identities across name changes, mergers, and acquisitions (e.g., rebranding and consolidation) so that the "actuarial firm" identifier reflects the economic organization providing the valuation services rather than the exact letterhead name in a given year. Appendix H describes the main categories of corrections to the PPD data.

Some plans in the sample conduct actuarial valuations on a biennial rather than annual cycle, or had one-off years without conducting an actuarial valuation. In off-valuation years, the PPD contains plan–year observations with financial and demographic data (such as market assets, payroll, and membership counts) but no actuarial valuation outputs (funded ratio, actuarial assets and liabilities, discount rate, or inflation assumption). For these observations, I carry forward the most recent valuation's figures. This treatment reflects standard practice in public pension reporting: between valuations, the previous actuarial determination remains the plan's official figure for funding and disclosure purposes. The carry-forward applies only to single-year gaps and fills approximately two-thirds of the missing actuarial values in the panel (1.5% of observations), with about 9.4% of plans having at least one year without an actuarial valuation.

4. Descriptive evidence

I begin by describing the structure of the actuarial market. For each actuarial firm, I compute the number of distinct plans it has ever served and the number of states in which those plans are located. Histograms of these counts (shown in panels (a) and (b) of Figure 1) reveal highly skewed distributions. A small set of large firms has served dozens of plans across many states, while a long-tail subset of observed actuarial firms serves only one or a few plans in a single state or region. Panel (c) of Figure 1 shows that firms that have served in multiple funds also have served in multiple states, as expected.

Consistent with casual perceptions, large national firms account for a disproportionate share of plan–years and liabilities in the sample. At the same time, there is a sizable group of smaller "boutique" firms that concentrate on a small client base, often within a single state. Over time, boutique firms appear to lose market share as plans migrate toward larger firms or internal staff, though small firms remain an important presence in the market.

I also examine the duration of plan–actuary relationships. Using the panel structure, I construct spells of continuous service by a given actuarial firm for each plan. The distribution of spell lengths is skewed toward long relationships: it is common for plans to retain the same actuary for a decade or longer. Switches of actuarial firms are relatively infrequent events, though they occur sufficiently often to identify firm-specific effects in the empirical analysis below.

These patterns motivate a coarse classification of actuarial firms into "large" and "boutique" types based on the breadth of their client base across plans and states. In what follows, I use such a classification to explore heterogeneity in the impact of actuary choice and switches. Specifically, I define an actuarial firm as small if it has served plans in fewer than 5 different states.

5. Actuarial firms and pension plan financials

5.1 Empirical strategy

Explanatory power of actuarial firm fixed effects. To quantify the contribution of actuarial firms to variation in reported financials, I estimate an AKM-style model. Let Y_{it} denote a measure of plan finances for plan i in fiscal year t (e.g., the funded ratio, log actuarial liabilities, log actuarial assets, or actuarial assumptions used), and let $a(i,t)$ denote the actuarial firm serving plan i in year t.[13] The baseline specification is:

$$Y_{it} = \alpha_i + \mu_t + \gamma_{a(i,t)} + \delta' X_{it} + \varepsilon_{it}, \tag{1}$$

where α_i are plan fixed effects, μ_t are year fixed effects, and $\gamma_{a(i,t)}$ are actuarial firm fixed effects.[14] The vector X_{it} includes time-varying plan fundamentals—membership, average wages and benefits, and market assets—that plausibly affect Y_{it} but are not directly driven by actuary choice.

Identification comes from plans that switch actuaries: changes in Y_{it} around a move from firm a to firm a' help pin down differences in γ_a versus $\gamma_{a'}$ after netting out plan and year effects and controls. Because not all plans and firms are linked by chains of switches, I restrict to the standard connected set when interpreting the *distribution* of firm effects.[15] At the same time, some substantively important providers—very small boutiques, regional single-client firms, and internal actuarial staffs—may fall outside the connected set; I therefore retain the full sample for descriptive exercises and event studies that do not require estimating the full system of firm effects, and show in the Appendix that restricting those analyses to the connected set yields similar patterns.

To summarize the descriptive importance of actuary effects, I report (i) the partial within R^2 attributable to actuarial firm indicators after partialling out plan and year fixed effects

[13] Plan reports are typically on a fiscal-year basis and valuation dates do not always coincide with fiscal year-end. I treat the PPD plan–year as the reporting year and align assumptions and actuary identity to the valuation underlying that year's reported liabilities whenever possible.

[14] Throughout, "actuarial firm effects" summarize systematic within-plan differences in reported outcomes associated with the identity of the actuarial firm, conditional on controls and fixed effects. They need not be purely causal if plans select actuaries based on time-varying unobservables correlated with reporting outcomes.

[15] The connected set is the largest component of the bipartite plan–actuary graph induced by observed switches: within this component, relative firm effects are identified by chains of mobility, whereas firms in isolated components cannot be placed on the same scale using switch-based comparisons.

and controls, and (ii) the increase in within-plan R^2 when adding actuarial firm fixed effects.[16] I estimate analogous specifications with actuarial assumptions (discount rates and inflation) as outcomes to assess whether firms that deliver more favorable reported financials also use systematically more aggressive assumptions.

Distribution of actuarial firm effects. Beyond summarizing explanatory power, I also characterize the distribution of actuarial firm effects across a range of outcomes. For this purpose, I restrict the sample to the connected set of plans and firms linked through switches and estimate equation (1) separately for the funded ratio, the logarithm of actuarial liabilities, the logarithm of actuarial assets, and key actuarial assumptions such as the discount rate and the inflation assumption.

On the connected set, the system of firm effects γ_a is identified up to a normalization, so cross-firm comparisons are well defined. I adopt the standard normalization implied by the high-dimensional fixed-effects estimator (which centers the firm effects around zero) and examine the dispersion of γ_a across actuaries by plotting histograms for different outcomes (funded ratios, liabilities, discount rates, actuarial assets, and inflation assumptions). I report differences between selected percentiles of these distributions. I also study the joint distribution of firm effects across outcomes (for example, the correlation between an actuary's effect on liabilities and its effect on the discount rate), so as to shed light on whether "optimistic" firms systematically combine high assumed returns with low reported liabilities.

To mitigate the influence of sampling noise, I report Empirical Bayes (EB) shrunken versions of the estimated firm effects (as in, for example, Chetty et al., 2014a,b; Angrist et al., 2017; Chetty and Hendren, 2018; Finkelstein et al., 2021; Abaluck et al., 2021; Lyubich, 2025). Conceptually, the raw firm effects from the AKM-style regressions combine persistent cross-firm differences in valuation practices with estimation error that is larger for firms observed in relatively few plan–years. The EB procedure uses two pieces of information—how dispersed the estimated firm effects are across firms, and how precisely each firm effect is estimated given that firm's sample size—to separate signal from noise. It then shrinks each firm's estimated effect toward zero (the overall mean) by an amount that depends on its estimated precision: effects for firms with many observations, which are estimated relatively precisely, are left largely unchanged, while effects for sparsely observed firms are pulled more strongly toward zero. I use these EB-shrunken firm effects when plotting the distributions and when relating firm effects across outcomes, so that the resulting patterns are not driven

[16] The partial within R^2 measures the share of residual within-plan variation explained by actuary indicators after partialling out plan and year fixed effects and other controls; the increase in within R^2 compares the within-fit of specifications with and without actuary indicators on the same estimation sample.

disproportionately by imprecisely estimated effects for small firms.[17]

Variance decomposition and the leave-one-out connected set. Using the AKM model estimates, it is standard to report a variance decomposition of the outcome into plan and actuarial firm components. Abstracting from the role of time-varying covariates, we can write:

$$\mathbb{V}(y_{it}) = \mathbb{V}(\alpha_i) + \mathbb{V}(\gamma_{a(i,t)}) + 2\,\mathbb{C}(\alpha_i, \gamma_{a(i,t)}) + \mathbb{V}(\varepsilon_{it}),$$

where $\mathbb{V}(\cdot)$ denotes the variance operator and $\mathbb{C}(\cdot)$ denotes the covariance operator. Each variance component summarizes the share of dispersion accounted for by heterogeneity in plan and actuarial firm fixed effects, while the covariance term is commonly interpreted as a measure of sorting. When the AKM identification assumptions hold, the estimated fixed effects are unbiased but the plug-in variance decomposition is not: because variance components are quadratic in estimated effects, estimation noise induces "limited mobility bias" and can spuriously attribute noise to the relative importance of firms (Andrews et al., 2008; Bonhomme et al., 2023). Since the identification of actuarial firm effects is ultimately based on switchers, this estimation error is inversely related to the number of movers per firm (Bonhomme et al., 2023; Lachowska et al., 2023). To address this issue, I implement the leave-out bias-correction method of Kline et al. (2020) and report the corresponding bias-corrected variance decompositions.

Implementing the leave-out correction requires restricting attention to the leave-one-out connected set, which ensures that each plan–firm link remains identified when any single observation is removed (Kline et al., 2020). This restriction strengthens identification but changes the estimand: the resulting variance shares characterize heterogeneity within the robustly connected core of the plan–actuary network, whereas plug-in decompositions computed on the broader connected set may capture additional heterogeneity associated with thinly connected firms and links. In what follows, I therefore treat the leave-out estimates as a conservative benchmark for the contribution of actuarial firm heterogeneity, and I complement them with plug-in decompositions and reduced-form evidence that do not rely on the leave-one-out restriction.

Small-network considerations. An important caveat is that the plan–actuary network studied here is considerably smaller than the worker–firm networks to which AKM methods are most commonly applied in labor economics, where samples often contain millions

[17] Empirical Bayes shrinkage is used as a regularization/presentation device to reduce the influence of imprecisely estimated firm effects; it does not change the underlying identifying variation, and all regressions and explanatory-power calculations use the raw fixed-effects estimates on the relevant sample.

of workers and thousands of firms. In this setting, the connected set comprises roughly 220 plans and 35 actuarial firms, with identification resting on a modest number of switches. While the AKM estimator remains consistent, the limited scale of the network has two consequences. First, individual firm effects are estimated less precisely than in larger networks, particularly for firms observed in few plan–years. The Empirical Bayes shrinkage described above addresses this by attenuating imprecisely estimated effects toward the overall mean. Second, limited mobility bias—the upward bias in plug-in variance components arising from estimation noise in the fixed effects—is a more acute concern in smaller networks, where fewer movers per firm inflate the noise-to-signal ratio (Andrews et al., 2008). I address this directly through the KSS bias-correction procedure described above.

Actuarial firm switching event study. While the AKM-style model provides a decomposition of variance, it is also informative to study the dynamics of financials around actuary switches. Two features of the setting make a standard two-way fixed-effects (TWFE) event study unsuitable. First, many plans switch actuarial firms more than once during the sample period, and I want to exploit all switches rather than artificially restricting attention to first switches only. Second, because plans switch at different points in time, a conventional TWFE specification can suffer from bias when treatment effects are heterogeneous across cohorts, as recently treated units may serve as implicit controls for earlier-treated units (De Chaisemartin and d'Haultfoeuille, 2020; Callaway and Sant'Anna, 2021; Sun and Abraham, 2021; Roth et al., 2023). To address both concerns simultaneously, I adopt a stacked difference-in-differences design in the spirit of Cengiz et al. (2019).

The stacked design proceeds as follows. For each cohort of plans that switch actuaries in the same calendar year, I construct a separate "sub-experiment" consisting of the switching plans (treated group) and a common set of never-switching plans (control group), observed over a symmetric window of four years before through three years after the event. If a plan switches more than once, each switch enters as a separate treated event in the relevant cohort sub-experiment. These cohort-specific sub-experiments are then stacked into a single dataset, and I estimate:

$$Y_{it,c} = \alpha_{ic} + \mu_{tc} + \sum_{k\neq -1} \beta_k \mathbb{1}\{\tau_{it} = k\} \cdot \text{Treat}_i + \delta' X_{it} + \varepsilon_{it,c}, \tag{2}$$

where c indexes the cohort-specific sub-experiment, α_{ic} denotes cohort-by-plan fixed effects, μ_{tc} denotes cohort-by-year fixed effects, and τ_{it} is the number of years relative to the switch year. By construction, $\tau_{it} = 0$ in the first year with the new firm, $\tau_{it} = -1$ in the last year with the old firm, and so on. The event-time indicators are interacted with a treatment dummy Treat_i so that never-switching controls contribute only to the estimation of fixed effects and the common time path, not to the event-time coefficients. I omit the indicator for $k = -1$ so that it serves as the reference period. The cohort-by-year fixed effects ensure that each treated cohort is compared only to its own set of clean controls, eliminating the "forbidden comparisons" that can bias conventional TWFE event studies.

The coefficients β_k trace out the average evolution of Y_{it} around the switch, relative to the pre-switch year $k = -1$. The identifying assumption is that, absent the switch, treated and never-switching control plans would have followed parallel trends within each cohort after conditioning on fixed effects and controls.

For the event-study analyses, I use the full sample of switches, including plans and firms that are not in the connected set, because the object of interest is the average change around a switch rather than the full system of firm effects. I estimate these event studies separately for different outcomes and explore heterogeneity across switch types. In the baseline heterogeneity figures, I distinguish switches between small (boutique) actuarial firms from all other switches.[18]

5.2 Empirical results

Explanatory power of actuarial firm fixed effects. I begin the empirical analysis by assessing, in a descriptive sense, how much actuarial firm fixed effects contribute to within-plan variation in reported outcomes. Table 2 reports results for six outcomes: the funded ratio, actuarial liabilities, actuarial assets, the discount rate, the required contribution (as a percentage of payroll), and the inflation assumption. For each outcome, I present a specification with only plan and year fixed effects alongside actuarial firm effects (odd columns) and one that adds controls for plan membership and market assets (even columns). Panel A summarizes the partial within R^2 attributable to actuarial firm effects and the increase in within-plan R^2 from adding them; Panel B reports coefficients on plan fundamentals.

Across outcomes, actuarial firm fixed effects materially increase within-plan fit. For the funded ratio, even with a rich set of controls, adding actuarial firm effects raises the within-plan R^2 by 3.1 percentage points relative to a baseline of 44% (column 2). Actuarial firm fixed effects explain a meaningful share of within-plan variation in liabilities even after conditioning on plan fundamentals and market assets, whereas their incremental contribution for actuarial assets is smaller once market assets are included—consistent with limited discretion on the

[18] Although substantively interesting, transitions into internal actuarial staff are rare in my sample: only one plan exhibits an observed switch from an external actuarial firm to an in-house actuarial office during the estimation window. As a result, I do not analyze this transition type separately, and instead focus on switch categories with sufficient support for credible event-study inference.

asset side beyond smoothing conventions. By contrast, actuarial firm effects have substantial explanatory power for assumptions: for discount rates, the within partial R^2 is around 6–7%, and for inflation assumptions it is around 7–8%, indicating that a nontrivial share of within-plan movements in valuation inputs is systematically related to the identity of the actuary. Appendix Tables D.2, D.3, D.4, and D.5 present the full set of specifications for each outcome, including controls for cross-outcome assumptions; these show that discount-rate and inflation assumptions co-move within plans, consistent with actuaries adjusting assumption sets in tandem.

Distribution of actuarial firm effects. The estimated actuarial firm effects exhibit substantial dispersion across outcomes, even after conditioning on plan fixed effects, year fixed effects, and plan fundamentals. Figure 4 plots the distribution of actuarial firm fixed effects (recentered to have mean zero) for the funded ratio, actuarial liabilities, actuarial assets, the discount rate, and required contributions, estimated on the largest connected set. Two patterns stand out. First, actuarial firms differ meaningfully in the financial outcomes they deliver. For the funded ratio (panel a), the interquartile range is 0.050, implying that moving from a firm at the 25th percentile to one at the 75th percentile is associated with roughly a 5.0 percentage-point difference in reported funding for otherwise comparable plans. For actuarial liabilities (panel b), the distribution is wider; the interquartile range is 5.9 log points, indicating economically meaningful cross-firm differences in reported liabilities even after absorbing persistent plan characteristics.

Second, heterogeneity is much more pronounced on the assumption side than on the actuarial-asset side. Actuarial-asset firm effects (panel c) are comparatively concentrated, with an interquartile range of 3.4 log points and only a small number of outlying firms—consistent with the fact that actuaries have limited discretion over the level of assets beyond the choice of smoothing rules. By contrast, discount-rate firm effects (panel d) show clear dispersion across actuaries (interquartile range 0.237 percentage points); Appendix Figure C.4 presents analogous results for an alternative actuarial assumption, the assumed rate of inflation. Panel (e) shows that actuarial firm effects on required contributions (employer plus employee, as a percentage of payroll) are also meaningfully dispersed, indicating that the differences in valuation practices documented in earlier panels translate into tangible fiscal consequences for plan sponsors. Taken together, the figure suggests that a key locus of actuarial influence is the selection and implementation of economic assumptions and valuation methods: firms that differ in their preferred assumption sets can generate systematically different reported liabilities, funded ratios, and required contributions, even when underlying plan fundamentals are held fixed.

Figure 5 relates estimated actuarial firm effects across outcomes and provides evidence on whether the same firms systematically move multiple objects in a coherent direction. Panel (a) shows a strong negative relationship between an actuary's funded-ratio effect and its liabilities effect: firms that are associated with higher reported funded ratios tend to be associated with lower reported actuarial liabilities. While this comovement is mechanically consistent with the funded ratio being the ratio of actuarial assets to actuarial liabilities, it is informative because it indicates that cross-firm differences in funded ratios are tightly linked to systematic differences in liability measurement, not solely to differences on the asset side.

Panel (b) shows a positive relationship between funded-ratio effects and actuarial-asset effects, but with a visibly weaker slope. This suggests that variation in actuarial asset smoothing and related practices contributes to cross-firm differences in funded outcomes, but appears secondary relative to liability-side differences. Taken together, panels (a) and (b) imply that the actuaries associated with higher funded ratios are, on average, those that combine somewhat higher reported actuarial assets with meaningfully lower reported actuarial liabilities.

Panels (c) and (d) connect liability-side firm effects to firm effects on other outcomes. In panel (c), the relationship between an actuary's log-liability effect and its discount-rate effect is modestly negative: firms associated with higher discount-rate effects tend, if anything, to be associated with lower reported liabilities, consistent with the mechanical mapping from higher discount rates to lower present values. Panel (d) shows a positive relationship between log-liability effects and required-contribution effects: firms associated with higher reported liabilities also tend to be associated with higher required contributions as a share of payroll. This is consistent with the mechanical link between liabilities and contribution requirements—actuaries whose valuation practices produce higher reported liabilities generate correspondingly larger funding gaps and hence larger required contributions for plan sponsors. Overall, Figure 5 reinforces the interpretation of the AKM estimates: actuarial firms behave as distinct reporting intermediaries, with correlated effects across liabilities, assets, assumptions, and fiscal outcomes rather than outcome-by-outcome idiosyncrasies.

Variance decomposition. Table 3 compares AKM-style variance decompositions computed (i) as a conventional plug-in decomposition on the connected set and (ii) using the KSS leave-out correction on the leave-one-out connected set. A first takeaway is that plan effects account for the bulk of residual variation across outcomes. This is expected: reported funding and accrued liabilities are fundamentally shaped by plan-specific benefit provisions, demographics, and historical funding choices that are highly persistent and idiosyncratic to particular plans.

At the same time, Panel A indicates that actuarial firm fixed effects explain a nontrivial share of residual dispersion in several objects—most notably the funded ratio and the core economic assumptions—even after residualizing on plan fundamentals and market-value assets. Because these plug-in variance shares are quadratic in estimated effects, however, they are potentially contaminated by limited-mobility bias: estimated firm effects can be unbiased but noisy in settings with limited switching, and the noise mechanically inflates variance components.

Panels B and C show what happens when moving to the stricter leave-one-out connected set required for the KSS correction. This restriction drops a substantial number of observations and, importantly, excludes a meaningful set of actuarial firms, mechanically tightening the analysis to a more densely connected core of the plan–actuary network. In practice, this can eliminate thinly connected but institutionally important providers—for example, boutique or regional firms that serve only one (or a handful of) plans and therefore generate few redundant mobility paths. Consistent with both the change in sample composition and the removal of limited-mobility bias, the estimated variance share attributable to actuarial firm effects is markedly smaller in the leave-one-out sample and in the KSS-corrected decomposition. I therefore interpret the KSS leave-out estimates as a conservative benchmark—likely a lower bound on the importance of actuarial firm heterogeneity in the broader market—and view the connected-set plug-in decomposition, together with the switch and small-firm evidence, as complementary evidence on the role of actuarial firms outside the tightly connected core.

Small actuarial firms. A limitation of connected-set analyses is that they naturally downweight or exclude very small and sporadically observed actuarial firms, precisely the boutique/regional providers that may serve only one (or a handful of) plans and therefore do not generate enough switching links to enter the largest connected component. Because these firms are institutionally important in the market and potentially operate under different incentives than large multi-plan firms, I complement the connected-set results with a specification that keeps the full sample and focuses directly on whether employing a small actuarial firm is associated with systematically different reported outcomes. Table 4 estimates plan and year fixed-effects regressions of key financials and assumptions on an indicator for a small actuarial firm, holding constant time-varying plan fundamentals.

The results show that, within a plan over time, years served by small actuarial firms are associated with materially stronger reported financials. In column (1), the coefficient implies a higher funded ratio by about 2.5 percentage points, and in column (2) small firms are associated with 3.0% lower reported actuarial liabilities, with both effects statistically significant.

In contrast, column (3) shows no meaningful difference in reported actuarial assets. Columns (4) and (5) indicate that small firms are associated with somewhat higher discount-rate and inflation assumptions, but these estimates are imprecise and not statistically distinguishable from zero. Taken together, the table suggests that the "small-firm" margin is linked to more favorable reported funding primarily through the liability side, while any systematic differences in stated economic assumptions are weaker in these reduced-form comparisons.

Actuarial firm switching event study. Figure 6 reports event-study estimates from equation (2), where coefficients are normalized to zero in the year immediately before the switch. Overall, the pooled dynamics suggest modest changes in reported financials around actuary transitions rather than large discrete breaks at the event date. Funded ratio coefficients (panel a) fluctuate within a narrow band throughout the event window, typically not statistically significant. A similar pattern is present for actuarial liabilities (panel c) and required contributions (panel e). Appendix Figure C.2 presents the corresponding event studies for actuarial assets, which show comparatively modest and imprecise movements, consistent with actuarial assets being harder to manipulate than liabilities.

Panels (b), (d), and (f) of Figure 6 then decompose these average patterns by switch type. Switches between small (boutique) actuarial firms are followed by increases in funded ratios in the post period—particularly two to three years after the switch—alongside declines in actuarial liabilities. Required contributions also decline for these small-to-small switches, consistent with the improvement in reported funding status translating into lower contribution burdens. In contrast, all other switches exhibit substantially more muted movements in all three outcomes, with funded ratios remaining close to zero and relatively small changes in liabilities and required contributions. This heterogeneity indicates that the average pooled response masks meaningful differences across switch types, and that the most pronounced post-switch changes are concentrated in transitions between smaller actuarial firms.

Taken at face value, the heterogeneity in Figure 6 is consistent with an economically meaningful "shopping" margin in the market for actuarial services. In particular, the fact that switches between small actuarial firms are followed by higher reported funded ratios, driven by lower reported liabilities and accompanied by lower required contributions, suggests that some plans may be able to improve measured financial health by changing the consultant who implements the valuation technology, even when underlying plan fundamentals are held fixed in the regression. Because funded ratios enter directly into contribution policy discussions, benefit negotiations, and external perceptions of fiscal health, even modest changes in reported funding can relax short-run political and budget constraints (Naughton et al., 2015).

At the same time, the muted dynamics for switches into large firms point to an important asymmetry: destination firms that are large may leave less scope for discretionary "re-packaging" of liabilities, if large firms follow more standardized methods or face stronger reputational discipline. By contrast, the larger post-switch shifts when plans move into boutique firms are consistent with a more elastic supply of reporting practices among small firms, or with a client base that is more willing to switch in search of favorable treatment. In that interpretation, the event studies imply that the relevant economic object is not only the level of pension risk, but also the mapping from risk into reported statistics—an outcome shaped by competition, bargaining, and incentives in the actuarial services market.

Importantly, these patterns do not by themselves prove intentional manipulation. They are also consistent with differential adoption of smoothing conventions, assumption updates, or valuation-cycle timing around switches. Nevertheless, the concentration of the post-switch changes in small-firm transitions—and their alignment with "better" reported financials—makes shopping a plausible mechanism and motivates future research on procurement frictions, fee schedules, and whether switches are preceded by periods of sponsor fiscal stress or heightened scrutiny.

5.3 Robustness checks

Restricting to the connected set. Some of the descriptive results in the main text are not restricted to the connected set, since several actuarial firms that are of analytic interest are not connected via switches (e.g., very small boutiques that appear only sporadically in the data, regional firms that serve a single plan over the sample window, or plans that use internal actuarial staff). Including these observations can be valuable for documenting the full actuarial landscape, but it also raises two related concerns. First, firms that never switch (or are never linked by a chain of switches) do not contribute to the relative identification of actuarial firm fixed effects, so any firm-level heterogeneity inferred from specifications that rely on cross-firm comparisons may be less interpretable outside the connected component. Second, isolated firms may differ systematically from the main connected market segment. To address these concerns, Appendix E re-estimates the main tables and figures after restricting the sample to the connected set only. The resulting measures of explanatory power and the associated coefficient patterns are very similar to the baseline, indicating that the central findings are not driven by firms that are disconnected from the switch-based identification structure.

Placebo outcomes. As a placebo check, Table D.1 in the Appendix reports the analogous variance decomposition for plan fundamentals: log active members, log beneficiaries, log market assets, log average salary, and log average pension. These variables should not be directly affected by actuarial discretion. Consistent with this, actuarial firm effects account for only 0.8–1.7% of the variance in fundamentals, far smaller than the shares observed for reported financials and assumptions. This pattern supports the interpretation that the actuarial firm variance shares for reported outcomes reflect genuine differences in valuation practices rather than spurious correlation with underlying plan characteristics.

Excluding plans with carried-forward actuarial values. Some pension plans conduct biennial rather than annual actuarial valuations. In off-years without a new valuation, the most recent actuarial values are carried forward. In total, 22 of 234 plans (9.4%) have at least one carried-forward observation, and carried-forward values account for 1.5% of all plan–year observations. To ensure that these stale values do not mechanically influence the results, Appendix F re-estimates all main analyses—including reconstructing the connected set, actuarial firm fixed effects, and stacked event-study samples—after dropping these 22 plans entirely. The results are very similar to the baseline, indicating that these plans are not a driving factor in the main results.

6. Lawsuits and pension plan financials

6.1 Empirical strategy

To study the impact of shocks to an actuary's incentives or reputation, I exploit lawsuits for actuarial malpractice brought by public pension plans. Using news articles, legal documents, and plan reports, I identify nine well-known lawsuits against seven distinct actuarial firms between 2005 and 2021, yielding seven first-lawsuit events in the empirical analysis (using the first lawsuit per firm). Most cases involve allegations that actuaries understated liabilities or otherwise misrepresented financial positions.[19]

These cases involve major actuarial firms and attracted considerable attention in the public pension community. Mercer was sued by Alaska in 2007 (settled 2010 for $500 million) and by Milwaukee County in 2006 (settled 2009 for $45 million).[20] Buck Consultants was sued by Stanislaus County retirees in October 2009 (a key appellate ruling in 2014 revived an aiding-and-abetting claim) and by the City of Providence in 2013 (Buck won summary

[19] Most cases involve public pension plans as plaintiffs. The CBIZ case involves a private hospital pension plan (UPMC Altoona), and the Segal case involves a municipal health-plan consulting dispute rather than pension actuarial work. I include these cases because both involve analogous allegations of actuarial negligence and are relevant to the reputation and incentives of firms that also serve public pension clients.

[20] Mercer later exited public pension actuarial consulting.

judgment in 2015). Gabriel, Roeder, Smith (GRS) was sued by the New Orleans Employers ILA fund in April 2005 (defense judgment affirmed 2008). Milliman's Maryland dispute proceeded through procurement/administrative channels, with a January 2010 Board of Contract Appeals decision, and culminated in a 2011 Court of Appeals decision upholding liability ($73 million). Houston sued Towers Perrin/Willis Towers Watson in March 2014 (settled 2018 for $40 million), UPMC sued CBIZ in September 2016 (settled 2021 for $41.5 million), and the City of Albuquerque sued Segal in 2021 (Segal won summary judgment in 2023).[21]

For each lawsuit, I define the event year as the first fiscal year whose end date falls on or after the lawsuit filing date (or, in Milliman's case, the date of the Board of Contract Appeals decision, since the dispute proceeded through procurement channels rather than a conventional lawsuit). Because plans have different fiscal year end dates, the same lawsuit can correspond to different event years for different plans: for example, a lawsuit filed in October 2009 falls within fiscal year 2009 for a plan with a December fiscal year end, but does not affect outcomes until fiscal year 2010 for a plan whose fiscal year ended in June. I then construct a treated sample of plans that employ the sued actuary in the event year but are not plaintiffs in that lawsuit.[22] I follow these plans in a window of years before and after the lawsuit, allowing them to have used different actuaries prior to, or after, the event year. In some cases the suing entity does not correspond to a plan in the PPD; in cases where the plaintiff plan is in the PPD, no suing plan is recorded as a client of the sued actuary in the event year. These non-suing clients are exposed to the sued actuary at the time of the lawsuit and are plausibly affected indirectly through changes in the firm's incentives, risk of liability, or reputation.

As with the switching analysis, the seven lawsuit events are staggered across time (2005–2021), so a conventional TWFE event study can suffer from forbidden comparisons when treatment effects are heterogeneous across cohorts (De Chaisemartin and d'Haultfoeuille, 2020; Callaway and Sant'Anna, 2021; Sun and Abraham, 2021). I therefore adopt the same stacked difference-in-differences design used for the switching event studies. For each lawsuit-year cohort, I construct a sub-experiment consisting of plans that employ the sued actuary in the event year (treated) and plans whose actuary was never sued while they were a client (controls), observed over a window of four years before through three years after the event. If a plan's actuary is sued more than once, only the first lawsuit enters as the treatment event.

[21] See Appendix B for details on each case.

[22] The treated group is defined based on employing the sued actuary in the event year; plans may switch away from the sued actuary in subsequent years. The event-study specification follows these plans over time and identifies average changes relative to the pre-event year, conditional on cohort-by-plan and cohort-by-year fixed effects.

These cohort-specific sub-experiments are then stacked into a single dataset, and I estimate:

$$Y_{it,c} = \alpha_{ic} + \mu_{tc} + \sum_{k \neq -1} \beta_k \mathbb{1}\{\kappa_{it} = k\} \cdot \text{Treat}_i + \delta' X_{it} + \varepsilon_{it,c}, \tag{3}$$

where c indexes the lawsuit-year cohort, α_{ic} denotes cohort-by-plan fixed effects, μ_{tc} denotes cohort-by-year fixed effects, κ_{it} is the number of years relative to the lawsuit year, and X_{it} are time-varying plan fundamentals as before. The event-time indicators are interacted with a treatment dummy Treat_i so that never-sued controls contribute only to the estimation of fixed effects and the common time path. I omit the indicator for $k = -1$, so that the year immediately before the lawsuit serves as the reference period. The cohort-by-year fixed effects ensure that each treated cohort is compared only to its own set of clean controls, eliminating forbidden comparisons.

I estimate these regressions for financial outcomes (the funded ratio, actuarial liabilities, and actuarial assets) and for actuarial assumptions (the discount rate and the inflation assumption). The coefficients β_k trace out the average evolution of outcomes around the lawsuit, relative to the pre-lawsuit year $k = -1$. The key parameters of interest are the post-event coefficients for $k \geq 0$, which capture whether non-suing clients of the sued actuary experience systematic changes in reported financials and assumptions after the lawsuit relative to their own pre-lawsuit levels and to never-sued plans in the same years.

6.2 Empirical results

Effect on financials. Figure 7 reports stacked event-study estimates from equation (3), with coefficients normalized to zero in the year immediately before the lawsuit ($k = -1$) and 95% confidence intervals. Panel (a) shows that funded ratios improve in the post-lawsuit period for plans that employ the sued actuary in the event year. In the years leading up to the lawsuit, coefficients are small and roughly flat. Beginning in the lawsuit year and continuing afterward, the funded-ratio coefficients turn positive and remain elevated, with economically meaningful increases on the order of 2 percentage points relative to the pre-lawsuit baseline.

Panel (b) shows that these funded-ratio improvements coincide with declines in reported actuarial liabilities. Liabilities are roughly flat in the pre-period, but fall after the lawsuit: the post-event coefficients are negative and persistent, consistent with a sustained reduction in reported liabilities. Panel (c) shows comparatively modest movements in actuarial assets: point estimates are mixed in the immediate post-lawsuit period but turn positive and grow by the end of the event window, though they remain less precisely estimated. Taken together, the patterns across panels (a)–(c) indicate that the post-lawsuit improvement in reported funding is driven primarily by liability-side changes rather than large shifts in actuarial assets.

Effect on assumptions and required contributions. Panels (d) and (e) provide evidence on mechanisms and fiscal consequences. Discount-rate coefficients rise after the lawsuit (panel (d)), with increases persisting through the end of the event window. The increase in the discount rate in the post-lawsuit years is about 5 basis points, which is both statistically and economically significant but alone would mechanically account for only a fraction of the observed liability decline (Appendix Figure C.4 presents the corresponding result for the inflation assumption). Panel (e) shows that required contributions (as a percentage of payroll) decline in the post-lawsuit period, consistent with the improvement in reported funding status translating into lower contribution burdens for plan sponsors.

Appendix Figure C.3 compares the event study coefficients for the baseline estimation and a specification that controls for the discount rate. Evidently, changes in the discount rate account for a significant share of the drop in actuarial liabilities, but the pattern of improved funding persists even after controlling for the discount rate.[23] This is consistent with existing work that has studied the role of the discount rate in reported liabilities (e.g. Novy-Marx and Rauh, 2009, 2011; Munnell et al., 2010), where increases in the discount rate of 1 percentage point are associated with about 10% reductions in liabilities. In this case, controlling for the discount rate reduces the estimated reduction of liabilities due to the lawsuit from about 2% to about 1.5%, which is roughly consistent with the magnitudes in those papers.

Overall, the lawsuit event studies point to more favorable reported financials for other clients of a sued actuary—higher funded ratios and lower reported liabilities—rather than a shift toward uniformly more conservative reporting. This pattern is consistent with lawsuits acting as shocks to the incentives and business environment of the actuarial firm, with subsequent changes propagating across its client base through the reporting channel.

6.3 Robustness checks

Excluding plans with carried-forward actuarial values. As discussed in Section 3, some plans in the sample conduct biennial rather than annual actuarial valuations, and in off-years the most recent actuarial values are carried forward. To the extent that carried-forward values mechanically dampen within-plan variation around event dates, they could distort the lawsuit event-study estimates. Appendix G.1 re-estimates the full lawsuit event study after dropping all 22 plans that ever had a carried-forward observation. The resulting coefficient paths are very similar to the baseline for all outcomes—funded ratios, actuarial liabilities, actuarial assets, the discount rate, and required contributions—confirming that

[23] Interpretation here should be careful, since the discount rate employed is itself an outcome of the lawsuit, so it constitutes a post-determined "bad control" (Angrist and Pischke, 2009).

the main findings are not an artifact of stale actuarial values.

Leave-one-out robustness. The lawsuit analysis relies on seven lawsuit events against seven actuarial firms, raising the concern that a single particularly influential case could drive the aggregate results. To assess this, I re-estimate the stacked event study dropping one lawsuit cohort at a time. Appendix G.2 reports these leave-one-out estimates for all main outcomes. The baseline point estimates fall well within the range of the leave-one-out paths, and no single omission materially changes the magnitude or significance of the post-lawsuit coefficients. This indicates that the findings reflect a common pattern across lawsuit events rather than being driven by any individual case—such as the large Alaska–Mercer settlement or the Maryland–Milliman procurement dispute.

Placebo outcomes. A potential concern with the lawsuit event study is that the post-lawsuit changes in reported financials could reflect coincidental shifts in underlying plan characteristics rather than changes in actuarial reporting. To address this, I re-estimate the lawsuit event study using plan fundamentals—log active members, log beneficiaries, log average salary, and log average pension—as dependent variables. These outcomes capture the demographic and compensation profile of plans and should not be directly affected by actuarial discretion or changes in reporting practices. Appendix G.3 shows that the placebo outcomes are flat throughout the event window, with no systematic pre- or post-lawsuit movements. This null result supports the interpretation that the main findings reflect changes in how actuaries report financial quantities—rather than changes in the underlying characteristics of the plans they serve.

7. Aggregate implications

The wide dispersion in actuarial firm fixed effects documented in Section 5 raises a natural question: how large are the aggregate consequences of actuarial firm heterogeneity for reported pension liabilities? The preceding analysis establishes that actuarial identity is associated with changes in plan-level outcomes, but the plan-level estimates alone do not reveal whether these effects are large enough to meaningfully shift the aggregate fiscal picture. To quantify the potential magnitude, I conduct a simple counterfactual exercise that reassigns all plans to a common actuarial firm drawn from a given point in the estimated firm-effect distribution.

Specifically, I replace each plan's actuarial firm fixed effect $\hat{\gamma}_a$ with the effect at either the 75th or 90th percentile of the firm-effect distribution for log actuarial liabilities, holding all other determinants of reported liabilities fixed. For each plan–year observation in the connected set, counterfactual liabilities are computed as $L_{it}^{CF} = L_{it} \times \exp(\gamma^p - \hat{\gamma}_{a(i,t)})$, where γ^p is the target percentile effect and $\hat{\gamma}_{a(i,t)}$ is the estimated (shrunken) effect of plan i's actual actuary in year t. Aggregating across all plans within each year yields the counterfactual time series of total reported actuarial liabilities.

Figure 8 presents the results. Panel (a) plots the additional liabilities relative to reported values under the AKM counterfactual. If every plan were served by the 75th-percentile actuarial firm, total reported liabilities in 2022 would be approximately \$134 billion higher than actually reported—an increase of about 2.1 percent. Shifting all plans to the 90th-percentile firm produces a substantially larger gap: roughly \$552 billion, or 8.8 percent, above reported totals. The gap has grown steadily over time in dollar terms as the overall stock of pension liabilities has expanded.

Panel (b) of Figure 8 quantifies a second source of underreporting: the leniency that sued actuarial firms extend to their clients after a lawsuit. Using the event-study coefficients from the lawsuit analysis in Section 6, I compute counterfactual liabilities by removing the estimated post-lawsuit decline in reported liabilities for each treated plan-year. The *baseline* scenario treats only plans that were already clients of the sued actuary at the time of the lawsuit, and the treatment persists even if the plan later switches to a different firm. The *pessimistic* scenario expands the treated set to also include clients acquired by the sued firm after the lawsuit, providing an upper bound on the extent of lawsuit-induced underreporting. The resulting underestimation grows stepwise as successive lawsuits accumulate treated plan-years: the baseline gap reaches approximately \$50 billion by 2022, while the pessimistic upper bound is larger. Although smaller than the AKM counterfactual, this effect is notable because it is driven by a specific, identifiable shock—legal action against the actuary—rather than by cross-sectional heterogeneity in firm styles.

These counterfactual exercises should be interpreted as illustrative rather than as precise policy forecasts. Both hold plan composition, investment returns, benefit provisions, and all other determinants constant. They do not account for potential behavioral responses that might follow from higher reported liabilities. Because pension funds are liability-driven institutions, changes in measured liabilities would cascade into contribution requirements, investment strategy, and benefit negotiations—channels that could amplify or partially offset the direct reporting effect. Moreover, the reported magnitudes are point estimates that inherit sampling uncertainty from the underlying regressions; formal confidence intervals are not computed. Nevertheless, the magnitudes are informative: they indicate that actuarial practice heterogeneity and incentive distortions documented in this paper are large enough to shift aggregate reported liabilities by tens to hundreds of billions of dollars, an economically significant amount relative to the scale of public pension underfunding in the United States.

8. Conclusion

This paper studies delegated measurement in the context of U.S. state and local defined benefit pension plans. Public pension actuaries are external experts who help measure long-term benefit promises and translate them into reported liabilities, funded ratios, assumptions, and required contributions. Using a newly assembled panel that links plan–year data from the Public Plans Database to actuarial firm identities and valuation assumptions, I document a concentrated market structure in which a small number of large multi-fund firms coexist with many boutique firms and internal actuarial staffs. Actuarial relationships are long-lived, although a subset of plans switch actuaries over the sample period.

Leveraging these switches, I estimate AKM-style panel models and find that actuarial firm fixed effects explain a nontrivial share of within-plan variation in funded ratios, actuarial liabilities, actuarial assets, required contributions, and key assumptions, even after conditioning on plan fundamentals and year effects. The estimated firm effects line up across outcomes in economically meaningful ways: actuaries associated with stronger reported funding are also associated with lower reported liabilities and more aggressive valuation assumptions. These patterns indicate that actuarial firms have coherent reporting styles rather than merely generating idiosyncratic noise.

Dynamic evidence reinforces this interpretation. Event-study analyses show that reported financials change when plans switch actuaries, particularly for switches involving boutique firms, and that these changes are concentrated in lower reported liabilities and improved funded ratios. Litigation events provide a second source of variation. Following malpractice lawsuits, other clients of the sued actuarial firm report stronger financial positions and use more aggressive assumptions, consistent with reputational and client-retention incentives shaping expert discretion. Counterfactual exercises suggest that actuarial firm heterogeneity can shift aggregate reported liabilities by tens to hundreds of billions of dollars, while post-lawsuit reporting changes imply that reported liabilities are lower by roughly \$50˜billion relative to a no-lawsuit-leniency benchmark.

Taken together, the findings show that public pension liabilities are not simply measured; they are produced through a market for expert measurement. Actuaries are not merely mechanical implementers of board-approved assumptions. They are measurement intermediaries whose identities, incentives, and market environment shape the financial picture that public pension plans present. Because measured liabilities anchor contribution policy, investment strategy, and assessments of benefit sustainability, the discretion documented here has implications beyond reported accounting numbers. It affects the fiscal benchmarks facing taxpayers, employers, plan boards, and policymakers.

The results speak to broader questions about delegated expertise and the production of financial information. Many institutions rely on external experts to measure or certify complex economic objects, from credit risk and asset values to insurance reserves and long-term benefit promises. This paper shows that, in one high-stakes setting, the identity and incentives of the expert measurer affect reported financial outcomes. For policymakers, the findings highlight the importance of robust oversight of actuarial practice, transparency about the role of actuaries, and mechanisms to mitigate conflicts of interest. For researchers, the results suggest that analyses of public pension finances should pay attention not only to reported liabilities, but also to the experts and incentives behind the numbers.

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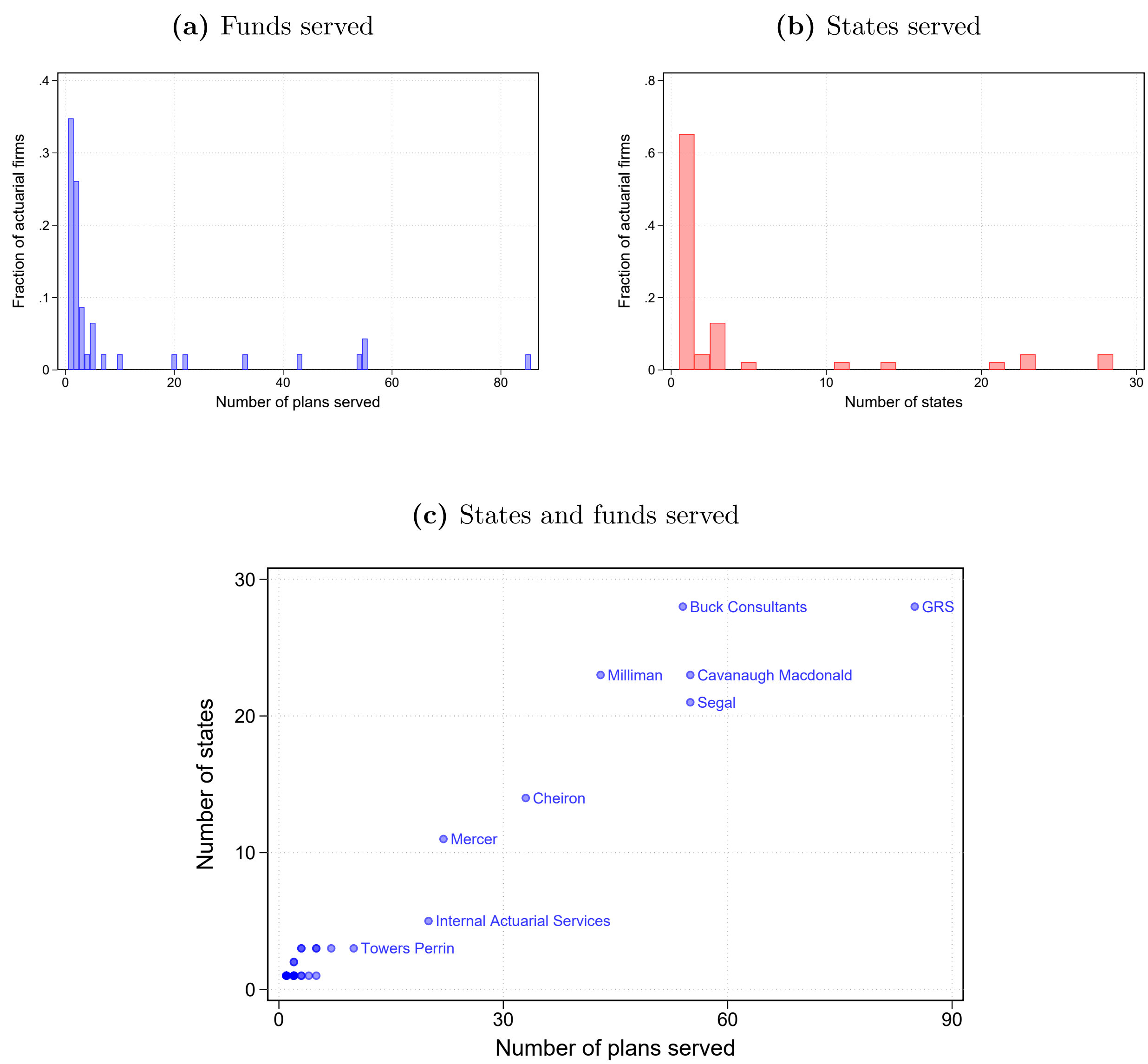
Figures

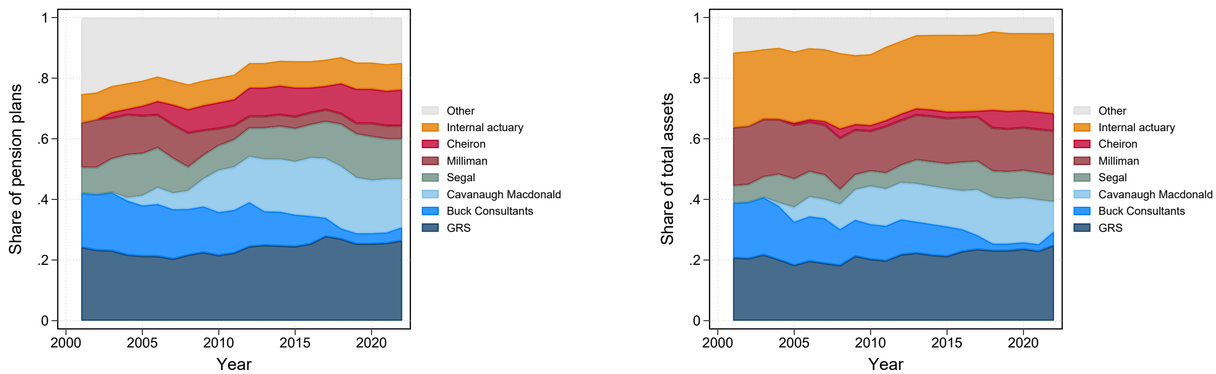
Figure 1: Funds and states served by actuarial firms



Notes: Panel (a) plots the histogram of the number of funds ever served by each actuarial firm. Panel (b) plots the histogram of the number of states in which each actuarial firm has ever served at least one plan. Panel (c) shows a scatterplot of, for each actuarial firm, the number of plans ever served and the number of states in which it has ever served.

Figure 2: Market share of actuarial firms over time

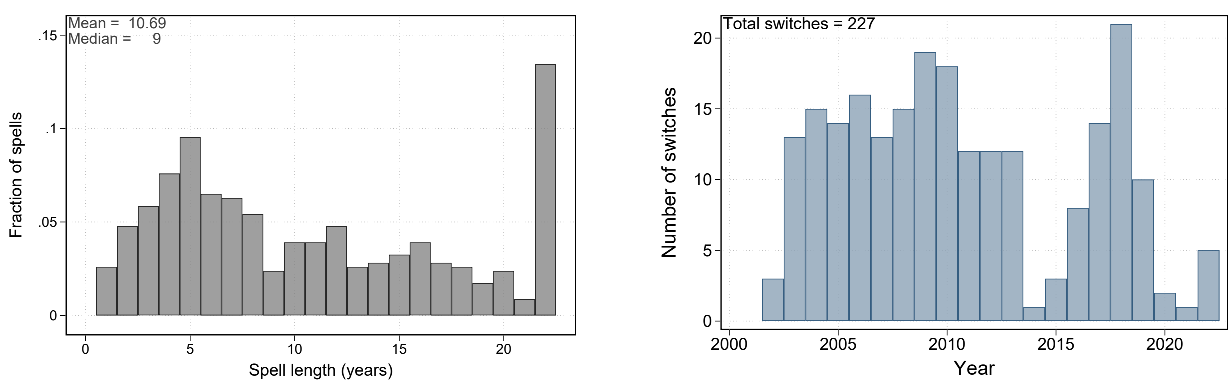
(a) Share of funds served by firm **(b)** Share of assets served by firm



Notes: Panel (a) plots, over time, the distribution of the share of funds served by each actuarial firm. Panel (b) plots, over time, the distribution of the share of total assets served by each actuarial firm.

Figure 3: Fund–actuary spell duration and switching activity

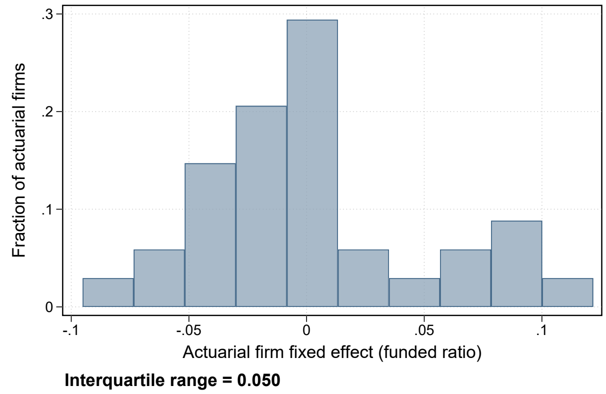
(a) Spell duration **(b)** Switches per year



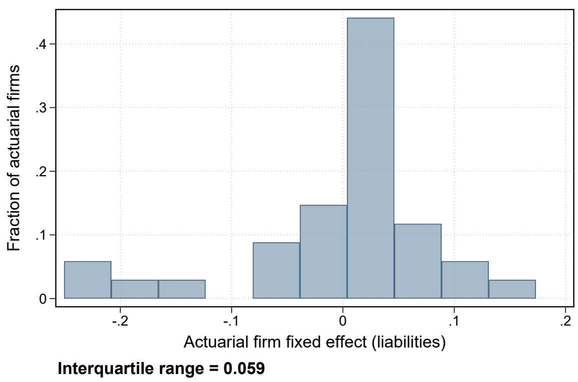
Notes: Panel (a) plots the distribution of the duration (in years) of continuous relationships between a pension fund and a given actuarial firm. Panel (b) plots the number of actuarial firm switches occurring in each year.

Figure 4: Distribution of actuarial firm fixed effects

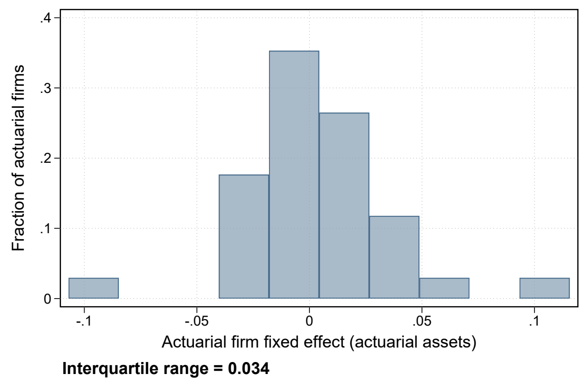
(a) Funded ratio



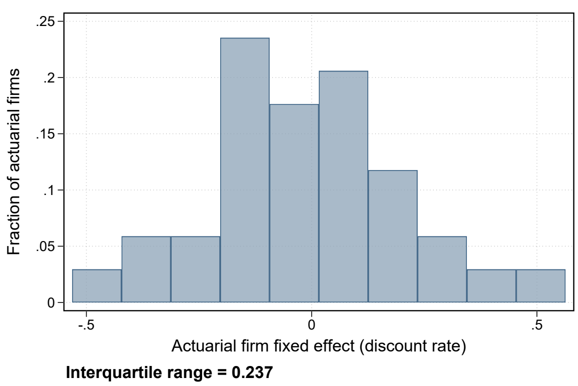
(b) Actuarial liabilities



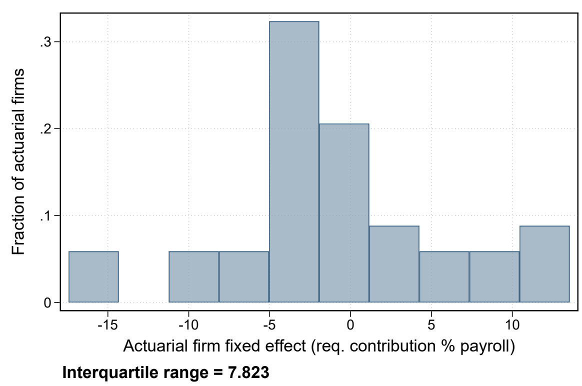
(c) Actuarial assets



(d) Discount rate



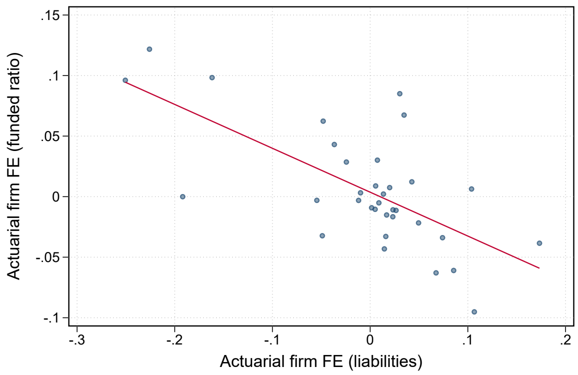
(e) Required contribution (% of payroll)



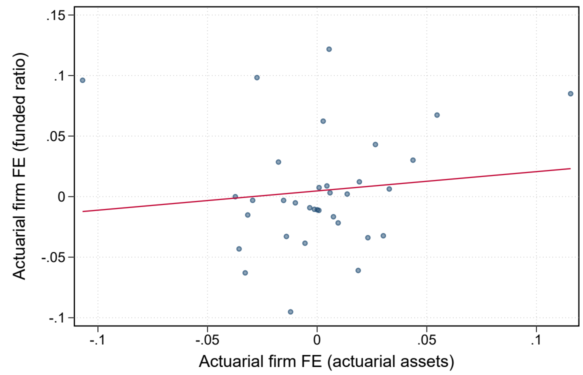
Notes: Each panel plots the distribution of actuarial firm fixed effects estimated on the largest connected set of plans and actuaries. Panel (a) shows the histogram of firm effects from the funded ratio regression, Panel (b) from the regression for the log of actuarial liabilities, Panel (c) for the log of actuarial assets, Panel (d) for the discount rate assumption (in percentage points), and Panel (e) for the required contribution as a percentage of payroll. Firm effects are obtained from AKM-style regressions that control for plan fixed effects, year fixed effects, and plan fundamentals, and are recentered so that their mean is zero. The vertical axis reports the fraction of actuarial firms in each bin.

Figure 5: Relationship between actuarial firm fixed effects across outcomes

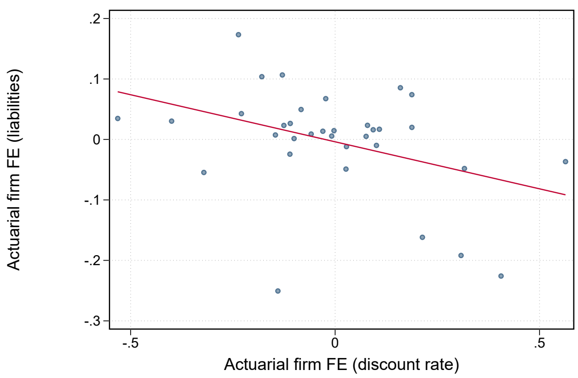
(a) Funded ratio vs. liabilities



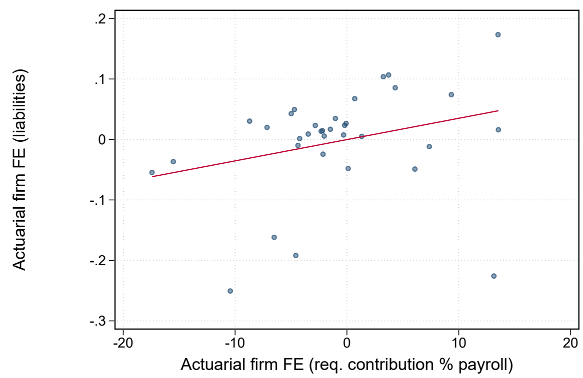
(b) Funded ratio vs. actuarial assets



(c) Liabilities vs. discount rate



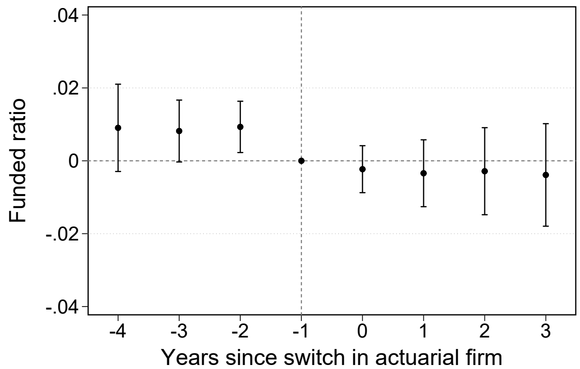
(d) Liabilities vs. required contribution



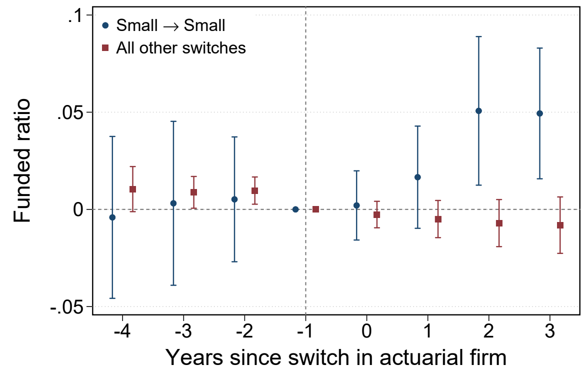
Notes: Each panel plots an actuarial firm-level scatterplot of shrunken fixed effects estimated on the largest connected set. Points correspond to actuarial firms (one observation per firm). The fitted line is the OLS best linear fit. Panel (a) relates funded-ratio effects to log-liability effects. Panel (b) relates funded-ratio effects to log actuarial-asset effects. Panel (c) relates log-liability effects to discount-rate effects (in percentage points). Panel (d) relates log-liability effects to required-contribution effects (as a percentage of payroll).

Figure 6: Switching event study

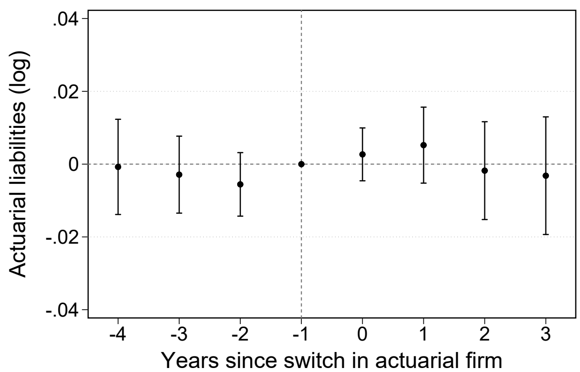
(a) Funded ratio – overall



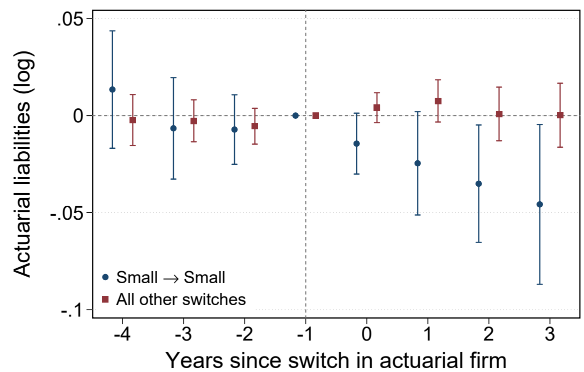
(b) Funded ratio – by switch type



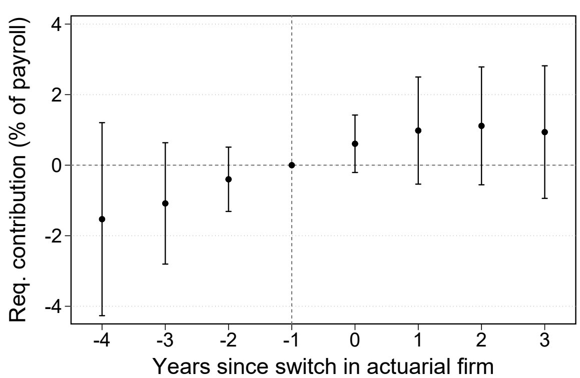
(c) Actuarial liabilities – overall



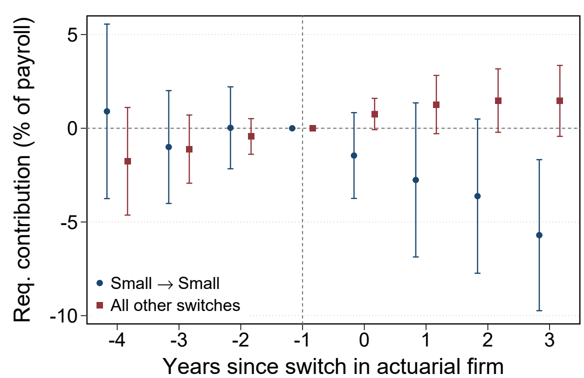
(d) Actuarial liabilities – by switch type



(e) Required contribution – overall



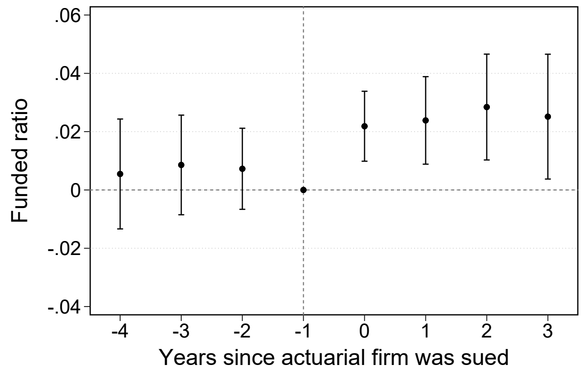
(f) Required contribution – by switch type



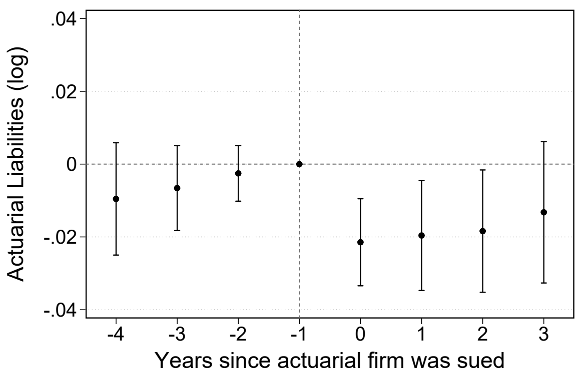
Notes: Panels (a), (c), and (e) plot stacked difference-in-differences event-study coefficients for the funded ratio, actuarial liabilities, and required contributions (as a percentage of payroll), respectively, around the year in which a pension plan switches actuarial firm. Panels (b), (d), and (f) plot the corresponding coefficients separately for switches between small actuarial firms (blue) versus all other switches (red). Coefficients are estimated from equation (2) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Coefficients are normalized to zero in the year immediately before the switch. Vertical bars represent 95% confidence intervals. Figure C.1 in the Appendix presents a finer decomposition into all four switch types. Appendix Figure C.2 presents the corresponding event studies for actuarial assets.

Figure 7: Lawsuit event study

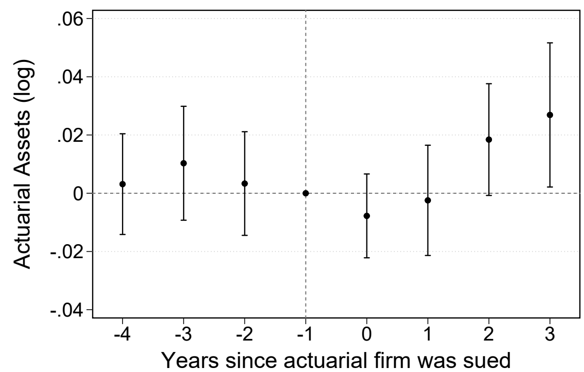
(a) Funded ratio



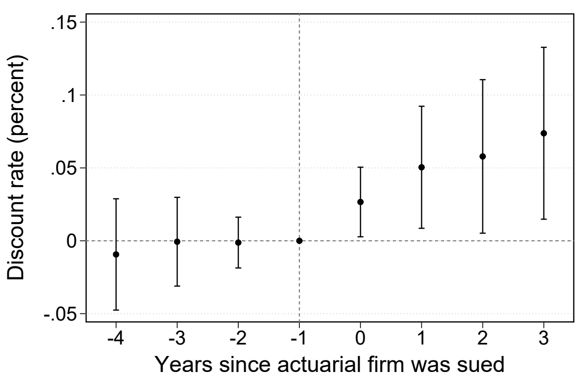
(b) Actuarial liabilities



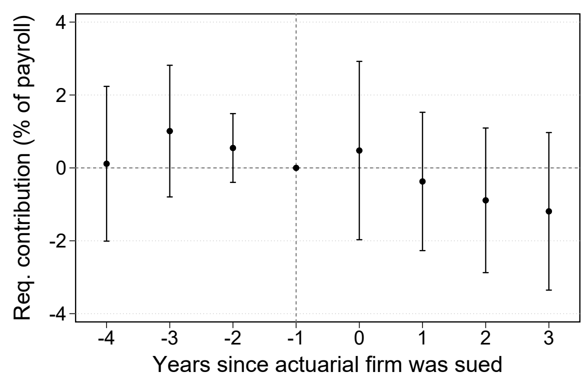
(c) Actuarial assets



(d) Discount rate



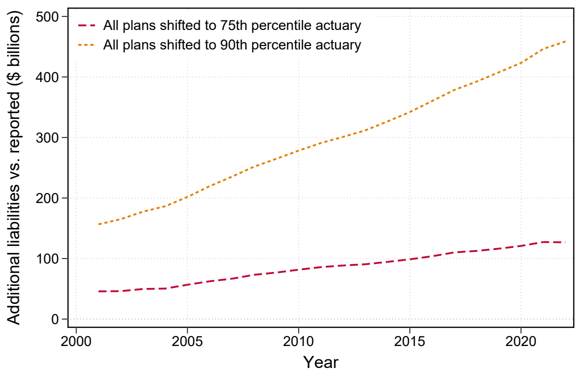
(e) Required contribution (% of payroll)



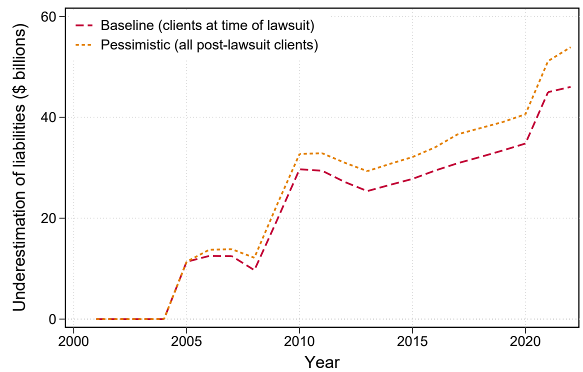
Notes: This figure plots stacked difference-in-differences event-study coefficients around the year in which an actuarial firm is sued for actuarial malpractice for several dependent variables. Panel (a) plots funded-ratio coefficients, panel (b) plots log actuarial liabilities, panel (c) plots log actuarial assets, panel (d) plots the discount rate (in percentage points), and panel (e) plots the required contribution as a percentage of payroll. The treated sample consists of pension plans that employ the sued actuarial firm in the year of the lawsuit. The control group consists of plans whose actuary was never sued while they were a client. Coefficients are estimated from equation (3) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. Vertical bars represent 95% confidence intervals.

Figure 8: Counterfactual aggregate liabilities

(a) AKM analysis counterfactuals



(b) Lawsuits analysis counterfactuals



Notes: This figure plots the gap between counterfactual and reported aggregate actuarial liabilities (in billions of dollars) for all plans in the connected set, 2001–2022. Panel (a) shows the AKM counterfactual: all plans are reassigned to the actuarial firm at the 75th or 90th percentile of the estimated firm fixed-effect distribution for log actuarial liabilities; firm fixed effects are estimated via AKM with Empirical Bayes shrinkage. Panel (b) removes the post-lawsuit leniency effect estimated from the lawsuit event study. For each treated plan-year, counterfactual liabilities are computed as $L_{it}^{CF} = L_{it} \times \exp(-\hat{\beta}_k)$, where $\hat{\beta}_k$ is the estimated event-study coefficient on log liabilities at event time k. The *baseline* scenario treats plans that were clients of the sued actuary at the time of the lawsuit, with treatment persisting even if the plan later switches firms. The *pessimistic* scenario expands this treated set to also include clients acquired by the sued firm after the lawsuit, providing an upper bound. See text for details.

Tables

Table 1: Summary Statistics

Variable	N	Mean	SD	P25	P50	P75
Funded ratio	4,929	0.785	0.198	0.671	0.792	0.912
Actuarial liabilities ($ billion)	4,929	18.28	38.49	1.55	5.52	18.82
Actuarial assets ($ billion)	4,929	14.16	30.23	1.21	4.44	13.60
Market assets ($ billion)	4,929	14.05	30.58	1.19	4.30	13.52
Active members (thousands)	4,929	59.8	111.6	4.0	14.6	71.3
Beneficiaries (thousands)	4,929	36.7	67.5	3.3	11.0	43.6
Average salary ($ thousands)	4,929	54.2	18.1	41.6	50.8	63.9
Average pension ($ thousands)	4,929	26.3	12.9	17.1	23.4	33.7
Discount rate (%)	4,929	7.63	0.55	7.25	7.75	8.00
Inflation assumption (%)	4,854	3.20	0.68	2.75	3.00	3.50
Required contribution (% of payroll)	4,606	29.19	28.71	14.94	22.36	33.73
Small actuarial firm	4,929	0.161	0.367	0.000	0.000	0.000

Notes: This table reports summary statistics for the main estimation sample. *Funded ratio* is actuarial assets divided by actuarial liabilities. *Actuarial liabilities* and *Actuarial assets* are the actuarial (smoothed) values reported in plan valuations, in billions of dollars. *Market assets* are plan assets at market value, in billions of dollars. *Active members* is the total number of active plan participants, in thousands. *Beneficiaries* is the total number of retirees receiving benefits, in thousands. *Average salary* is the average salary among active members, in thousands of dollars. *Average pension* is the average annual benefit paid to retirees, in thousands of dollars. *Discount rate* is the assumed rate of return used for the actuarial valuation, in percentage points. *Inflation assumption* is the assumed rate of inflation, in percentage points. *Small actuarial firm* is an indicator equal to one if the plan's actuary is a small actuarial firm as described in the text.

Table 2: Explanatory power of actuarial firm fixed effects

	Funded ratio		Act. liabilities		Act. assets		Discount rate		Inflation		Req. Contrib.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Explanatory power of actuarial firm fixed effects												
Partial within R^2	0.063	0.054	0.067	0.091	0.049	0.026	0.065	0.065	0.076	0.076	0.047	0.053
Increase in within R^2	0.063	0.031	0.067	0.020	0.049	0.002	0.065	0.065	0.076	0.075	0.047	0.026
Panel B. Control coefficients												
Active members (log)		-0.0635***		0.141***		0.0289***		-0.0317		-0.0435		-52.17***
		(0.0133)		(0.0156)		(0.00872)		(0.0729)		(0.0523)		(5.919)
Beneficiaries (log)		-0.215***		0.331***		0.0387***		0.0277		-0.125*		0.142
		(0.0259)		(0.0293)		(0.0142)		(0.0573)		(0.0749)		(2.189)
Average salary (log)		-0.219***		0.363***		0.0186		0.0771		0.231		-19.31*
		(0.0445)		(0.0673)		(0.0340)		(0.194)		(0.274)		(11.39)
Average pension (log)		-0.146***		0.316***		0.0527**		-0.0756		0.328*		18.53***
		(0.0319)		(0.0521)		(0.0235)		(0.102)		(0.172)		(5.566)
Market assets (log)		0.390***		0.225***		0.897***		0.109		0.123		2.115
		(0.0233)		(0.0442)		(0.0194)		(0.106)		(0.104)		(4.450)
Within R^2 (No actuary FE)	0.000	0.438	0.000	0.785	0.000	0.906	0.000	0.007	0.000	0.012	0.000	0.516
Obs.	4929	4929	4929	4929	4929	4929	4854	4854	4854	4854	4606	4606
Pension plans	234	234	234	234	234	234	233	233	233	233	234	234

Notes: This table reports, for six pension plan outcomes, measures of explanatory power for actuarial firm fixed effects and estimated regression coefficients for control variables. The outcomes are the funded ratio (columns 1–2), the natural logarithm of actuarial liabilities (columns 3–4), the natural logarithm of actuarial assets (columns 5–6), the discount rate in percentage points (columns 7–8), the inflation assumption in percentage points (columns 9–10), and the required contribution as a percentage of payroll (columns 11–12). Odd-numbered columns include only plan and year fixed effects and actuarial firm fixed effects; even-numbered columns add controls for plan membership (log active members, log beneficiaries, log average salary, log average pension) and log market assets. Panel A shows the within partial R^2 and the increase in within R^2 from including actuarial firm fixed effects. Panel B shows the coefficients for control variables. Standard errors are clustered at the plan level. Appendix Tables D.2, D.3, D.4, and D.5 present the full set of specifications. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 3: Variance decomposition

	Funded Ratio		Act. Liabilities		Act. Assets		Discount Rate		Inflation		Req. Contrib.	
	Level	Percent	Level	Percent	Level	Percent	Level	Percent	Level	Percent	Level	Percent
Panel (a): Plug-in on Full Connected Set												
Var(Y)	107.315	100%	0.031	100%	0.005	100%	0.191	100%	0.272	100%	440.660	100%
Plan effects	77.253	72.0%	0.025	80.1%	0.003	56.1%	0.139	73.0%	0.132	48.5%	302.812	68.7%
Actuarial firm effects	14.645	13.6%	0.001	3.0%	0.001	25.9%	0.022	11.6%	0.074	27.2%	19.363	4.4%
2 × Cov(Plan, Firm)	-25.363	-23.6%	-0.002	-6.3%	-0.002	-49.8%	-0.033	-17.5%	-0.064	-23.6%	-26.192	-5.9%
Residual	40.779	38.0%	0.007	23.2%	0.003	67.8%	0.063	33.0%	0.131	48.0%	144.678	32.8%
Observations	4,667		4,667		4,667		4,667		4,611		4,414	
Plans	220		220		220		220		219		220	
Actuarial firms	34		34		34		34		34		34	
Panel (b): Plug-in on Leave-One-Out Connected Set												
Var(Y)	93.121	100%	0.025	100%	0.004	100%	0.202	100%	0.268	100%	268.937	100%
Plan effects	55.781	59.9%	0.020	78.0%	0.002	36.3%	0.139	68.7%	0.118	44.1%	149.912	55.7%
Actuarial firm effects	4.214	4.5%	0.001	3.1%	0.000	3.0%	0.009	4.2%	0.028	10.4%	14.146	5.3%
2 × Cov(Plan, Firm)	-3.815	-4.1%	-0.001	-5.1%	-0.000	-4.4%	-0.009	-4.5%	-0.013	-4.8%	2.377	0.9%
Residual	36.941	39.7%	0.006	24.0%	0.003	65.1%	0.064	31.6%	0.135	50.3%	102.501	38.1%
Observations	4,154		4,154		4,154		4,154		4,025		3,946	
Plans	199		199		199		199		195		199	
Actuarial firms	25		25		25		25		22		24	
Panel (c): KSS (Bias-corrected) on Leave-One-Out Connected Set												
Var(Y)	93.121	100%	0.025	100%	0.004	100%	0.202	100%	0.268	100%	268.937	100%
Plan effects	53.262	57.2%	0.019	75.6%	0.001	32.0%	0.124	61.6%	0.095	35.5%	143.102	53.2%
Actuarial firm effects	3.487	3.7%	0.001	2.6%	0.000	1.7%	0.008	3.8%	0.026	9.6%	12.644	4.7%
2 × Cov(Plan, Firm)	-3.026	-3.2%	-0.001	-4.6%	-0.000	-2.6%	-0.008	-4.1%	-0.010	-3.8%	3.822	1.4%
Residual	39.398	42.3%	0.007	26.4%	0.003	68.9%	0.078	38.6%	0.157	58.7%	109.368	40.7%
Observations	4,154		4,154		4,154		4,154		4,025		3,946	
Plans	199		199		199		199		195		199	
Actuarial firms	25		25		25		25		22		24	

Notes: This table reports the variance decomposition of pension plan outcomes into plan fixed effects, actuarial firm fixed effects, and their covariance. "Level" shows the variance of each component; "Percent" shows the share of total variance. Outcomes are first residualized on plan size controls (log active members, log beneficiaries, log average salary, log average pension) and log assets. Funded ratio is presented in percentage terms for ease of interpretation. Panel (a) reports naive plug-in estimates on the full connected set. Panel (b) reports naive plug-in estimates on the leave-one-out connected set. Panel (c) reports KSS bias-corrected estimates (Kline et al., 2020). Shares may not sum to 100% due to residual variance.

Table 4: Small actuarial firms and reported pension financials

	(1) Funded ratio	(2) Actuarial Liabilities (log)	(3) Actuarial Assets (log)	(4) Discount rate	(5) Inflation assumption	(6) Req. Contrib. (% payroll)
Small actuarial firm	0.023*	-0.031*	0.001	0.040	0.070	4.137*
	(0.013)	(0.017)	(0.007)	(0.045)	(0.073)	(2.412)
Active members (log)	-0.064***	0.142***	0.027***	-0.013	-0.051	-52.333***
	(0.013)	(0.016)	(0.009)	(0.076)	(0.052)	(6.001)
Beneficiaries (log)	-0.217***	0.334***	0.035**	0.021	-0.152*	-0.378
	(0.026)	(0.031)	(0.014)	(0.061)	(0.085)	(2.330)
Average salary (log)	-0.226***	0.377***	0.016	0.066	0.138	-16.649
	(0.045)	(0.068)	(0.034)	(0.186)	(0.258)	(11.392)
Average pension (log)	-0.145***	0.311***	0.057**	-0.085	0.318*	20.162***
	(0.032)	(0.052)	(0.023)	(0.100)	(0.172)	(5.234)
Market assets (log)	0.388***	0.235***	0.903***	0.089	0.140	2.799
	(0.023)	(0.043)	(0.019)	(0.105)	(0.108)	(4.793)
Year FE	✓	✓	✓	✓	✓	✓
Plan FE	✓	✓	✓	✓	✓	✓
Plans	234	234	234	234	233	234
Observations	4929	4929	4929	4929	4854	4606

Notes: This table reports estimates of the association between employing a small actuarial firm and reported pension plan financials and assumptions. Each column reports a separate plan–year regression with plan fixed effects and year fixed effects. The dependent variables are, respectively, the funded ratio, the natural logarithm of actuarial liabilities, the natural logarithm of actuarial assets, the discount rate (in percentage points), the inflation assumption (in percentage points), and the required contribution as a percentage of payroll. The indicator *Small actuarial firm* equals one when the plan's actuary is classified as a small (boutique) firm. All specifications control for plan fundamentals: the natural logarithm of active members, the natural logarithm of beneficiaries, the natural logarithm of average salary, the natural logarithm of average pension, and the natural logarithm of market-value assets. Standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

A. Connected set and Empirical Bayes shrinkage

This appendix describes (i) how I construct the largest connected set of pension plans and actuarial firms and (ii) how I obtain Empirical Bayes (EB) shrunken estimates of actuarial firm effects.

A.1 Largest connected set of plans and actuarial firms

The empirical setting can be represented as an undirected bipartite network between pension plans and actuarial firms. A link exists between plan i and firm a if firm a is observed valuing plan i in at least one year in the sample window. Two plans are in the same connected component if they can be linked through a chain of shared actuarial firms (possibly via other plans), and analogously two firms are connected if they share (directly or indirectly) a chain of overlapping clients.

To construct connected components, I start from the set of unique plan–firm pairs observed in the data and view them as edges in an undirected bipartite graph. I then assign an initial component label to every plan and to every firm and iteratively propagate labels along the observed edges: each plan inherits the minimum label among its neighboring firms and each firm inherits the minimum label among its neighboring plans. Repeating these updates until convergence partitions plans and firms into disjoint connected components such that any plan and firm in the same component are mutually reachable via some path, while no edges connect distinct components.

Among the resulting components, I focus on the *largest connected component* (LCC), defined as the component that contains the greatest number of plan–year observations in the panel. All actuarial firm effects used in the shrinkage procedure are estimated on this largest connected set. Observations belonging to plans and firms in smaller, isolated components are excluded from the construction of firm effects.

A.2 Estimation of actuarial firm effects

Within the LCC, I estimate a series of linear regressions of the form

$$Y_{it} = \alpha_i + \mu_t + \gamma_{a(i,t)} + \delta' X_{it} + \varepsilon_{it},$$

where Y_{it} is, in turn, the funded ratio, the logarithm of actuarial liabilities, the discount rate, the logarithm of actuarial assets, the inflation assumption, or contributions as a share of payroll. The specification includes plan fixed effects α_i, year effects μ_t, and actuarial firm effects $\gamma_{a(i,t)}$, as well as a vector of time-varying plan fundamentals X_{it} (e.g., membership and benefit measures, and market assets).

Operationally, I absorb plan fixed effects and include year and firm indicators explicitly. Inference for the outcome regressions is computed using standard errors clustered at the plan level. To obtain firm-specific measures of estimation uncertainty needed for EB shrinkage under a mean-zero normalization, I work with the variance-covariance matrix of the estimated coefficients.

Because firm indicators are identified only up to a normalization, I express the actuarial firm effects as deviations from the average firm effect within the connected set. Let $\hat{\gamma}_j$ denote the estimated coefficient on firm j (relative to an omitted base firm) and let $\bar{\gamma}$ denote the average across firms in the LCC. For each firm j, I compute the centered effect

$$\widehat{\gamma}_j^{\,c} \;=\; \hat{\gamma}_j - \bar{\gamma}.$$

In the implementation, these centered effects are obtained as linear combinations of the estimated firm-indicator coefficients, so that a standard error is available for *every* firm (including the omitted base category). I then treat the squared standard error of $\widehat{\gamma}_j^{\,c}$ as a firm-specific noise variance proxy for shrinkage.

A.3 Empirical Bayes shrinkage of firm effects

For each outcome, I view the centered firm effects as noisy estimates of underlying true firm heterogeneity:

$$\widehat{\gamma}_j^{\,c} = \gamma_j^c + \eta_j, \qquad \mathbb{E}[\eta_j] = 0, \quad \mathrm{Var}(\eta_j) = \sigma_j^2.$$

I estimate the firm-specific noise variances as

$$\widehat{\sigma}_j^2 \;=\; \widehat{\mathrm{se}}\Big(\widehat{\gamma}_j^{\,c}\Big)^2,$$

where $\widehat{\mathrm{se}}(\cdot)$ is the standard error of the centered effect obtained from the regression variance-covariance matrix.

Let $\widehat{\mathrm{Var}}(\widehat{\gamma}^{\,c})$ denote the cross-sectional variance of the centered estimated firm effects across firms in the LCC, and let $\overline{\sigma^2}$ denote the (unweighted) average of the firm-specific noise variances $\widehat{\sigma}_j^2$. I estimate the variance of the underlying true firm effects (the "signal variance") as

$$\widehat{\tau}^2 \;=\; \max\Big\{\,\widehat{\mathrm{Var}}(\widehat{\gamma}^{\,c}) - \overline{\sigma^2},\; 0\,\Big\}.$$

Finally, I compute EB shrinkage weights

$$\hat{w}_j \; = \; \frac{\widehat{\tau}^2}{\widehat{\tau}^2 + \widehat{\sigma}_j^2},$$

and define the shrunken firm effect as

$$\widehat{\gamma}_j^{EB} \; = \; \hat{w}_j \, \widehat{\gamma}_j^{c}.$$

Firms with more precisely estimated effects (smaller $\widehat{\sigma}_j^2$) receive weights closer to one and are shrunk little; firms with noisier estimates receive smaller weights and are pulled more strongly toward zero (the mean effect under the centering normalization).

I apply this procedure separately for each outcome. The resulting EB-shrunken firm effects summarize heterogeneity across actuarial firms while attenuating sampling variation. These shrunken effects are used in the main text to characterize the distribution of actuary effects, study correlations across outcomes (e.g., between effects on liabilities and discount rates), and construct measures of changes in firm effects around actuarial firm switches.

B. Actuarial malpractice lawsuits

Mercer (Marsh & McLennan). In December 2007 the State of Alaska sued Mercer over alleged actuarial errors that understated pension and retiree-health liabilities for the PERS/TRS systems; after extensive discovery and pre-trial motion practice, the parties settled on June 11, 2010, with Mercer paying $500,000,000 while denying wrongdoing. Separately, Milwaukee County and its Employees' Retirement System sued Mercer in March 2006 in federal court over negligent pension projections linked to a benefits package adopted in the early 2000s; as a jury trial got underway, the case was resolved on May 19, 2009 via a $45,000,000 settlement, again without an admission of liability.

Buck Consultants. Retirees from the Stanislaus County retirement association (Nasrawi) filed suit against Buck in October 2009 alleging that Buck's actuarial practices facilitated fiduciary breaches and masked underfunding; a key development came on November 6, 2014, when the California Court of Appeal revived an aiding-and-abetting claim and remanded, and no later published merits judgment has surfaced. The City of Providence sued Buck in 2013 claiming negligent pension-cost projections tied to expected savings from COLA changes; on November 13, 2015 the federal court granted summary judgment to Buck, holding the city's damages theory too speculative. (Earlier litigation by IBEW Local 380 in the Eastern District of Pennsylvania also pressed negligence/misrepresentation claims over cost estimates, which survived to later stages but did not result in a plaintiff verdict.)

Gabriel, Roeder, Smith & Co. (GRS). The New Orleans Employers International Longshoremen's Association Pension Fund sued GRS in April 2005 in the Eastern District of Louisiana, alleging faulty calculations connected to lump-sum or benefit determinations; following a bench trial the court entered judgment for GRS, and the Fifth Circuit affirmed in 2008, rejecting the actuarial-malpractice theory.

Milliman. Maryland's dispute with Milliman proceeded through the state's procurement channel rather than a conventional tort suit: after an adverse procurement-officer decision and a Maryland State Board of Contract Appeals ruling that found breach tied to actuarial error and under-contributions, judicial review culminated on July 20, 2011, when the Maryland Court of Appeals upheld liability and reinstated an award on the order of $73,000,000 for lost contributions and investment earnings. Because there was no conventional lawsuit filing date, I use January 2010—the date of the Board of Contract Appeals decision—as the event date.

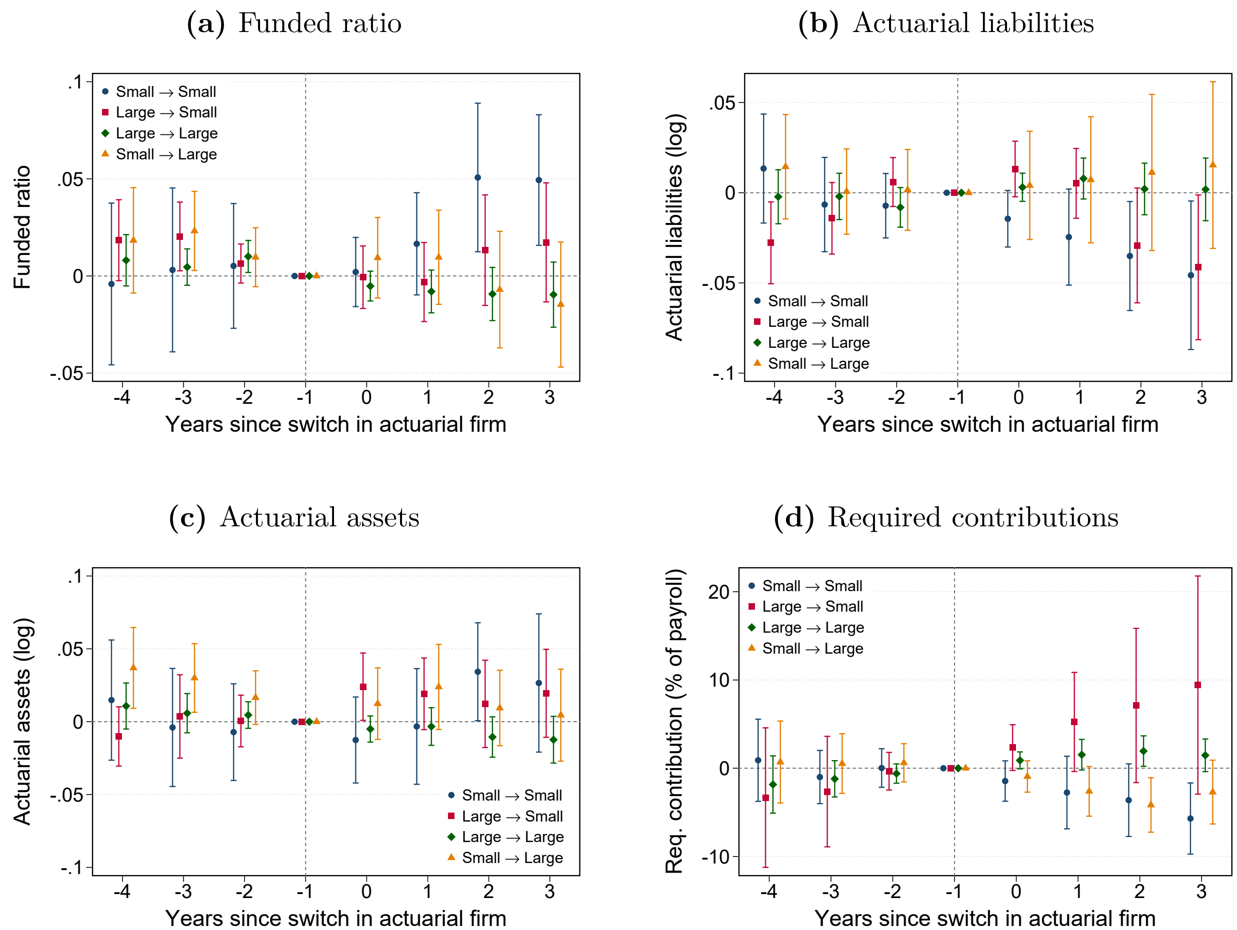
Towers Perrin / Willis Towers Watson (now WTW). The City of Houston filed suit in March 2014 alleging that Towers' actuarial and consulting advice from the early 2000s materially understated the long-run costs of firefighter pension enhancements; after several years of litigation, the parties settled on March 23, 2018 for $40,000,000, with no admission of wrongdoing.

CBIZ. UPMC and UPMC Altoona sued CBIZ and a named actuary in September 2016, alleging a negligent understatement—by well over $100,000,000—of the Altoona hospital's pension liabilities discovered during and after UPMC's acquisition; the matter advanced toward trial and was resolved in mid-2021 with a $41,500,000 settlement paid by CBIZ.

Segal. The City of Albuquerque sued The Segal Company in March 2021 (removed to federal court shortly thereafter) alleging negligence and misrepresentation in benefits/actuarial consulting during a health-plan transition; after motion practice and discovery, the district court granted summary judgment for Segal on September 29, 2023, dismissing the case with prejudice.

C. Additional figures

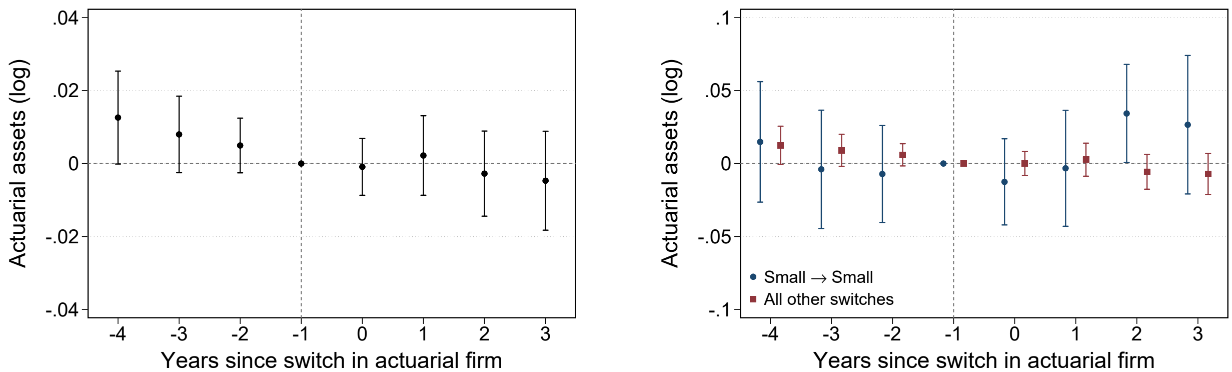
Figure C.1: Switching event study – four switch types



Notes: Each panel plots stacked difference-in-differences event-study coefficients by type of switch. Coefficients are estimated from equation (2) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Blue (Small → Small) denotes switches between small actuarial firms, red (Large → Small) denotes switches from a large to a small firm, green (Large → Large) denotes switches between large firms, and orange (Small → Large) denotes switches from a small to a large firm. Vertical bars represent 95% confidence intervals.

Figure C.2: Switching event study – actuarial assets

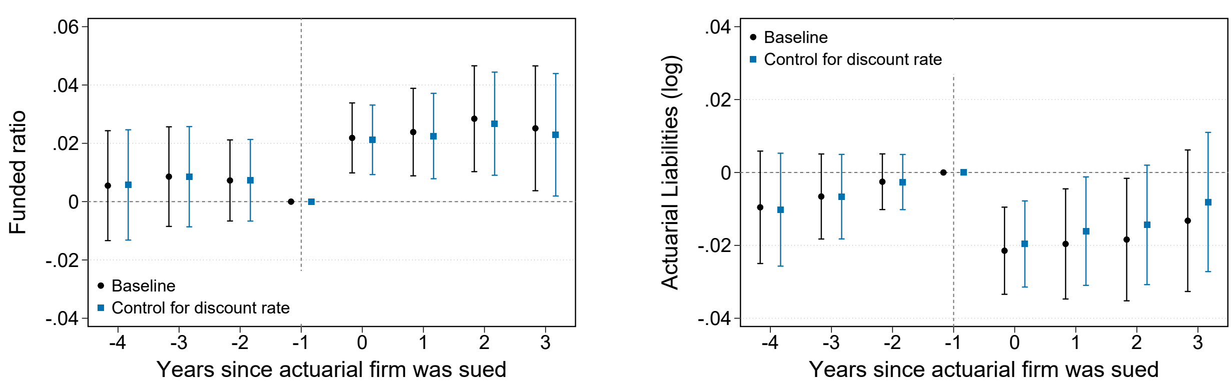
(a) Overall **(b)** By switch type



Notes: Panel (a) plots stacked difference-in-differences event-study coefficients for actuarial assets around the year in which a pension plan switches actuarial firm. Panel (b) plots the corresponding coefficients separately for switches between small actuarial firms (blue) versus all other switches (red). Coefficients are estimated from equation (2) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Coefficients are normalized to zero in the year immediately before the switch. Vertical bars represent 95% confidence intervals.

Figure C.3: Lawsuit event study robustness: controlling for the discount rate

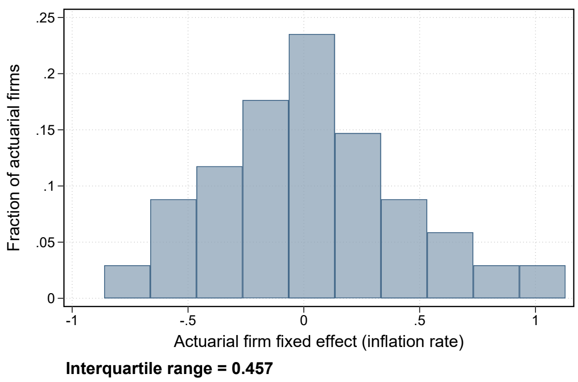
(a) Funded ratio **(b)** Actuarial liabilities



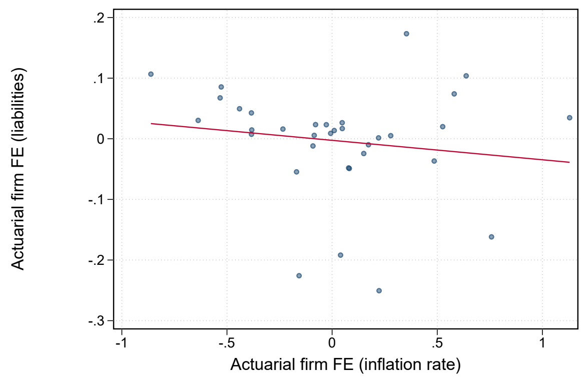
Notes: Each panel overlays stacked event-study coefficients from the baseline lawsuit specification and a specification that additionally controls for the plan–year discount rate. Coefficients are estimated from equation (3) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans whose actuary was never sued while they were a client. Vertical bars report 95% confidence intervals; standard errors are clustered at the plan level.

Figure C.4: Inflation assumption results

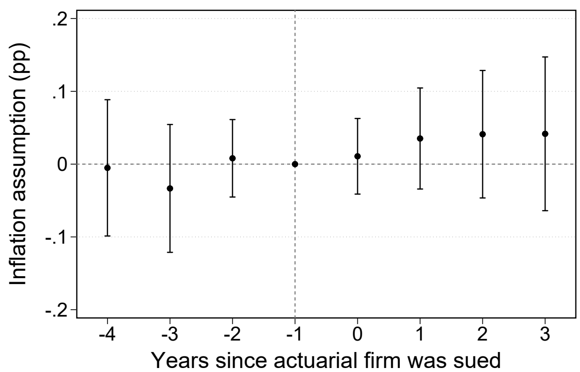
(a) Distribution of firm effects



(b) Liabilities vs. inflation assumption



(c) Lawsuit event study



Notes: This figure presents results for the inflation assumption, an alternative actuarial assumption. Panel (a) plots the distribution of actuarial firm fixed effects for the inflation assumption (in percentage points), estimated on the largest connected set. Panel (b) plots the relationship between log-liability firm effects and inflation-assumption firm effects. Panel (c) plots stacked difference-in-differences event-study coefficients for the inflation assumption around actuarial malpractice lawsuits. The estimation details for each panel mirror those of the corresponding main-text figures (Figures 4, 5, and 7, respectively).

D. Additional tables

Table D.1: Variance decomposition: plan fundamentals (placebo)

	Log Active Members		Log Beneficiaries		Log Assets		Log Avg Salary		Log Avg Pension	
	Level	Percent	Level	Percent	Level	Percent	Level	Percent	Level	Percent
Panel (a): Plug-in on Full Connected Set										
Var(Y)	0.440	100%	0.358	100%	0.347	100%	0.035	100%	0.101	100%
Plan effects	0.397	90.2%	0.322	89.7%	0.325	93.7%	0.030	88.1%	0.090	88.9%
Actuarial firm effects	0.006	1.4%	0.005	1.4%	0.005	1.3%	0.000	1.1%	0.002	1.8%
2 × Cov(Plan, Firm)	-0.005	-1.1%	0.001	0.3%	-0.005	-1.4%	0.001	2.1%	0.000	0.2%
Residual	0.041	9.4%	0.031	8.5%	0.022	6.4%	0.003	8.7%	0.009	9.0%
Observations	4,667		4,667		4,667		4,667		4,667	
Plans	220		220		220		220		220	
Actuarial firms	35		35		35		35		35	
Panel (b): Plug-in on Leave-One-Out Connected Set										
Var(Y)	0.280	100%	0.235	100%	0.333	100%	0.031	100%	0.084	100%
Plan effects	0.254	90.6%	0.213	90.6%	0.321	96.4%	0.027	88.6%	0.077	91.2%
Actuarial firm effects	0.005	1.6%	0.003	1.3%	0.003	0.9%	0.000	1.0%	0.002	1.9%
2 × Cov(Plan, Firm)	-0.001	-0.3%	0.002	1.0%	-0.007	-2.1%	0.000	0.9%	-0.002	-2.2%
Residual	0.023	8.1%	0.017	7.1%	0.016	4.8%	0.003	9.4%	0.008	9.2%
Observations	4,154		4,154		4,154		4,154		4,154	
Plans	199		199		199		199		199	
Actuarial firms	26		26		26		26		26	
Panel (c): KSS (Bias-corrected) on Leave-One-Out Connected Set										
Var(Y)	0.280	100%	0.235	100%	0.333	100%	0.031	100%	0.084	100%
Plan effects	0.248	88.5%	0.208	88.5%	0.320	96.1%	0.027	88.2%	0.076	90.5%
Actuarial firm effects	0.004	1.5%	0.003	1.2%	0.003	0.8%	0.000	0.8%	0.001	1.7%
2 × Cov(Plan, Firm)	-0.001	-0.2%	0.003	1.1%	-0.007	-2.0%	0.000	1.2%	-0.002	-1.9%
Residual	0.029	10.2%	0.022	9.2%	0.017	5.1%	0.003	9.8%	0.008	9.7%
Observations	4,154		4,154		4,154		4,154		4,154	
Plans	199		199		199		199		199	
Actuarial firms	26		26		26		26		26	

Notes: This table reports the variance decomposition of plan fundamentals—variables that should not be directly affected by actuarial discretion—into plan fixed effects, actuarial firm fixed effects, and their covariance. The format mirrors Table 3. Panel (a) reports naive plug-in estimates on the full connected set. Panel (b) reports naive plug-in estimates on the leave-one-out connected set. Panel (c) reports KSS bias-corrected estimates (Kline et al., 2020). Across all panels and outcomes, actuarial firm effects account for a negligible share of the variance in plan fundamentals, supporting the interpretation that the firm-effect variance shares for reported outcomes in Table 3 reflect genuine differences in valuation practices rather than spurious correlation with underlying plan characteristics. Shares may not sum to 100% due to residual variance.

Table D.2: Actuarial firms and funded ratio (full specifications)

	Funded ratio					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Explanatory power of actuarial firm fixed effects						
Partial within R^2	0.063	0.063	0.063	0.059	0.054	0.050
Increase in within R^2	0.063	0.061	0.054	0.057	0.031	0.027
Panel B. Control coefficients						
Active members (log)		0.0139			-0.0635***	-0.0622***
		(0.0269)			(0.0133)	(0.0128)
Beneficiaries (log)		-0.0607**			-0.215***	-0.217***
		(0.0288)			(0.0259)	(0.0254)
Average salary (log)		-0.107			-0.219***	-0.225***
		(0.0717)			(0.0445)	(0.0437)
Average pension (log)		0.0346			-0.146***	-0.143***
		(0.0411)			(0.0319)	(0.0316)
Market assets (log)			0.163***		0.390***	0.386***
			(0.0365)		(0.0233)	(0.0208)
Discount rate				0.0548***		0.0492***
				(0.0149)		(0.00827)
Within R^2 (No actuary FE)	0.000	0.030	0.138	0.034	0.438	0.464
Obs.	4929	4929	4929	4929	4929	4929
Pension plans	234	234	234	234	234	234

Notes: This table reports, for the funded ratio, measures of explanatory power for actuarial firm fixed effects and estimated regression coefficients for control variables. In all columns, the dependent variable is the funded ratio. Panel A shows the within partial R^2 and the increase in within R^2 from including actuarial firm fixed effects. Panel B shows the coefficients for control variables. *Active members* is the natural logarithm of the total number of active plan members. *Beneficiaries* is the natural logarithm of the total number of plan beneficiaries. *Average salary* is the logarithm of the average salary among active members. *Average pension* is the average benefit paid to retired members. *Market assets (log)* is the natural logarithm of plan assets at market value. *Discount rate* is the discount rate used for the actuarial valuation, in percentage points. Standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table D.3: Actuarial firms, actuarial liabilities, and actuarial assets (full specifications)

	Actuarial liabilities						Actuarial assets					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Explanatory power of actuarial firm fixed effects												
Partial within R^2	0.067	0.094	0.082	0.065	0.091	0.081	0.049	0.072	0.024	0.050	0.026	0.026
Increase in within R^2	0.067	0.024	0.037	0.064	0.020	0.016	0.049	0.037	0.002	0.050	0.002	0.002
Panel B. Control coefficients												
Active members (log)		0.186***			0.141***	0.139***		0.207***			0.0289***	0.0292***
		(0.0237)			(0.0156)	(0.0138)		(0.0483)			(0.00872)	(0.00901)
Beneficiaries (log)		0.420***			0.331***	0.334***		0.394***			0.0387***	0.0383***
		(0.0296)			(0.0293)	(0.0279)		(0.0450)			(0.0142)	(0.0140)
Average salary (log)		0.428***			0.363***	0.373***		0.277**			0.0186	0.0170
		(0.0710)			(0.0673)	(0.0666)		(0.137)			(0.0340)	(0.0333)
Average pension (log)		0.420***			0.316***	0.310***		0.469***			0.0527**	0.0536**
		(0.0598)			(0.0521)	(0.0516)		(0.0895)			(0.0235)	(0.0235)
Market assets (log)			0.615***		0.225***	0.232***			0.951***		0.897***	0.896***
			(0.0656)		(0.0442)	(0.0399)			(0.0111)		(0.0194)	(0.0187)
Discount rate				-0.0517**		-0.0831***				0.0587		0.0141**
				(0.0261)		(0.0130)				(0.0415)		(0.00668)
Within R^2 (No actuary FE)	0.000	0.745	0.548	0.010	0.785	0.807	0.000	0.483	0.904	0.006	0.906	0.907
Obs.	4929	4929	4929	4929	4929	4929	4929	4929	4929	4929	4929	4929
Pension plans	234	234	234	234	234	234	234	234	234	234	234	234

Notes: This table reports, for actuarial liabilities and actuarial assets, measures of explanatory power for actuarial firm fixed effects and estimated regression coefficients for control variables. In columns 1 to 6 the dependent variable is the natural logarithm of actuarial liabilities. In columns 7 to 12 the dependent variable is the natural logarithm of actuarial assets. Panel A shows the within partial R^2 and the increase in within R^2 from including actuarial firm fixed effects. Panel B shows the coefficients for control variables. *Active members* is the natural logarithm of the total number of active plan members. *Beneficiaries* is the natural logarithm of the total number of plan beneficiaries. *Average salary* is the logarithm of the average salary among active members. *Average pension* is the average benefit paid to retired members. *Market assets (log)* is the natural logarithm of plan assets at market value. *Discount rate* is the discount rate used for the actuarial valuation, in percentage points. Standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table D.4: Actuarial firms, discount rate, and inflation assumption (full specifications)

	Discount rate						Inflation assumption					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Explanatory power of actuarial firm fixed effects												
Partial within R^2	0.065	0.066	0.065	0.061	0.065	0.061	0.076	0.077	0.077	0.072	0.076	0.071
Increase in within R^2	0.065	0.066	0.064	0.059	0.065	0.058	0.076	0.076	0.077	0.069	0.075	0.067
Panel B. Control coefficients												
Active members (log)		-0.0102			-0.0317	-0.0259		-0.0192			-0.0435	-0.0346
		(0.0721)			(0.0729)	(0.0741)		(0.0543)			(0.0523)	(0.0579)
Beneficiaries (log)		0.0706*			0.0277	0.0443		-0.0768			-0.125*	-0.133*
		(0.0406)			(0.0573)	(0.0552)		(0.0644)			(0.0749)	(0.0727)
Average salary (log)		0.111			0.0771	0.0465		0.269			0.231	0.209
		(0.202)			(0.194)	(0.187)		(0.281)			(0.274)	(0.263)
Average pension (log)		-0.0258			-0.0756	-0.119		0.385**			0.328*	0.349**
		(0.101)			(0.102)	(0.103)		(0.170)			(0.172)	(0.172)
Market assets (log)			0.103		0.109	0.0927			0.0834		0.123	0.0929
			(0.0782)		(0.106)	(0.104)			(0.0838)		(0.104)	(0.102)
Inflation assumption				0.132***		0.133***						
				(0.0238)		(0.0236)						
Discount rate										0.281***		0.280***
										(0.0598)		(0.0599)
Within R^2 (No actuary FE)	0.000	0.003	0.006	0.041	0.007	0.049	0.000	0.010	0.001	0.041	0.012	0.054
Obs.	4854	4854	4854	4854	4854	4854	4854	4854	4854	4854	4854	4854
Pension plans	233	233	233	233	233	233	233	233	233	233	233	233

Notes: This table reports, for the discount rate and the inflation assumptions, measures of explanatory power for actuarial firm fixed effects and estimated regression coefficients for control variables. In columns 1 to 6 the dependent variable is the discount rate (in percent). In columns 7 to 12 the dependent variable is the inflation assumption (in percent). Panel A shows the within partial R^2 and the increase in within R^2 from including actuarial firm fixed effects. Panel B shows the coefficients for control variables. *Active members* is the natural logarithm of the total number of active plan members. *Beneficiaries* is the natural logarithm of the total number of plan beneficiaries. *Average salary* is the logarithm of the average salary among active members. *Average pension* is the average benefit paid to retired members. *Market assets (log)* is the natural logarithm of plan assets at market value. *Discount rate* is the discount rate used for the actuarial valuation, in percentage points. Standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table D.5: Actuarial firms and required contribution (full specifications)

	Req. Contrib. (% payroll)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Explanatory power of actuarial firm fixed effects						
Partial within R^2	0.047	0.055	0.055	0.046	0.053	0.054
Increase in within R^2	0.047	0.027	0.052	0.045	0.026	0.026
Panel B. Control coefficients						
Active members (log)		-51.66***			-52.17***	-52.34***
		(5.865)			(5.919)	(5.970)
Beneficiaries (log)		0.958			0.142	0.263
		(2.137)			(2.189)	(2.116)
Average salary (log)		-18.59			-19.31*	-18.92*
		(11.55)			(11.39)	(11.18)
Average pension (log)		19.49***			18.53***	18.01***
		(5.093)			(5.566)	(5.552)
Market assets (log)			-20.50***		2.115	2.564
			(6.595)		(4.450)	(4.245)
Discount rate				-4.728		-4.529*
				(4.763)		(2.492)
Within R^2 (No actuary FE)	0.000	0.515	0.066	0.008	0.516	0.522
Obs.	4606	4606	4606	4606	4606	4606
Pension plans	234	234	234	234	234	234

Notes: This table reports, for the required contribution as a percentage of payroll (employer plus employee), measures of explanatory power for actuarial firm fixed effects and estimated regression coefficients for control variables. Panel A shows the within partial R^2 and the increase in within R^2 from including actuarial firm fixed effects. Panel B shows the coefficients for control variables. *Active members* is the natural logarithm of the total number of active plan members. *Beneficiaries* is the natural logarithm of the total number of plan beneficiaries. *Average salary* is the logarithm of the average salary among active members. *Average pension* is the average benefit paid to retired members. *Market assets (log)* is the natural logarithm of plan assets at market value. *Discount rate* is the discount rate used for the actuarial valuation, in percentage points. Standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

E. Connected set only

This appendix reproduces the main table results while restricting the sample to the largest connected set of plans and actuarial firms (i.e., plan–actuary pairs that are linked through at least one chain of switches). The specifications, fixed effects structure, and controls mirror those in the main text; the only difference is the connected-set restriction.

Table E.1: Actuarial firms and funded ratios (connected set only)

	Funded ratio					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Explanatory power of actuarial firm fixed effects						
Partial within R^2	0.060	0.059	0.062	0.057	0.055	0.052
Increase in within R^2	0.060	0.058	0.054	0.055	0.031	0.028
Panel B. Control coefficients						
Active members (log)		0.0104			-0.0660***	-0.0647***
		(0.0274)			(0.0131)	(0.0126)
Beneficiaries (log)		-0.0605**			-0.218***	-0.219***
		(0.0300)			(0.0271)	(0.0265)
Average salary (log)		-0.0845			-0.232***	-0.234***
		(0.0819)			(0.0451)	(0.0438)
Average pension (log)		0.0310			-0.146***	-0.141***
		(0.0420)			(0.0331)	(0.0327)
Market assets (log)			0.153***		0.390***	0.386***
			(0.0368)		(0.0245)	(0.0220)
Discount rate				0.0538***		0.0469***
				(0.0149)		(0.00854)
Within R^2 (No actuary FE)	0.000	0.028	0.126	0.032	0.435	0.459
Obs.	4667	4667	4667	4667	4667	4667
Pension plans	220	220	220	220	220	220

Notes: This table replicates Table D.2 on the connected set only. Panel A reports the within partial R^2 of actuarial firm fixed effects and the increase in within R^2 from including actuarial firm fixed effects. Panel B reports coefficients on controls. All specifications include plan and year fixed effects; standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table E.2: Actuarial firms, liabilities, and assets (connected set only)

	Actuarial liabilities						Actuarial assets					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Explanatory power of actuarial firm fixed effects												
Partial within R^2	0.066	0.096	0.081	0.063	0.093	0.083	0.047	0.069	0.025	0.048	0.027	0.028
Increase in within R^2	0.066	0.024	0.035	0.062	0.019	0.015	0.047	0.034	0.002	0.048	0.002	0.002
Panel B. Control coefficients												
Active members (log)		0.191***			0.146***	0.144***		0.206***			0.0291***	0.0295***
		(0.0242)			(0.0154)	(0.0137)		(0.0498)			(0.00874)	(0.00904)
Beneficiaries (log)		0.422***			0.330***	0.332***		0.400***			0.0351**	0.0348**
		(0.0307)			(0.0312)	(0.0293)		(0.0474)			(0.0144)	(0.0142)
Average salary (log)		0.496***			0.410***	0.413***		0.391**			0.0503	0.0498
		(0.0681)			(0.0691)	(0.0682)		(0.153)			(0.0350)	(0.0338)
Average pension (log)		0.414***			0.311***	0.302***		0.455***			0.0456**	0.0470**
		(0.0616)			(0.0537)	(0.0525)		(0.0920)			(0.0230)	(0.0232)
Market assets (log)			0.629***		0.227***	0.235***			0.954***		0.901***	0.900***
			(0.0662)		(0.0468)	(0.0419)			(0.0107)		(0.0200)	(0.0194)
Discount rate				-0.0607**		-0.0848***				0.0523		0.0130*
				(0.0268)		(0.0134)				(0.0429)		(0.00680)
Within R^2 (No actuary FE)	0.000	0.754	0.564	0.013	0.792	0.814	0.000	0.501	0.910	0.004	0.913	0.913
Obs.	4667	4667	4667	4667	4667	4667	4667	4667	4667	4667	4667	4667
Pension plans	220	220	220	220	220	220	220	220	220	220	220	220

Notes: This table replicates Table D.3 on the connected set only. Columns 1–6 report results for the log of actuarial liabilities and columns 7–12 report results for the log of actuarial assets. Panel A reports the within partial R^2 of actuarial firm fixed effects and the increase in within R^2 from including actuarial firm fixed effects. Panel B reports coefficients on controls. All specifications include plan and year fixed effects; standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table E.3: Actuarial firms and economic assumptions (connected set only)

	Discount rate						Inflation assumption					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Explanatory power of actuarial firm fixed effects												
Partial within R^2	0.061	0.061	0.061	0.058	0.060	0.057	0.075	0.075	0.075	0.072	0.075	0.072
Increase in within R^2	0.061	0.060	0.060	0.056	0.060	0.055	0.075	0.075	0.075	0.070	0.074	0.069
Panel B. Control coefficients												
Active members (log)		-0.0132			-0.0363	-0.0306		-0.0227			-0.0468	-0.0375
		(0.0741)			(0.0751)	(0.0763)		(0.0569)			(0.0547)	(0.0595)
Beneficiaries (log)		0.0669*			0.0192	0.0332		-0.0641			-0.114	-0.119
		(0.0388)			(0.0568)	(0.0548)		(0.0673)			(0.0805)	(0.0783)
Average salary (log)		0.0464			-0.00164	-0.0340		0.313			0.263	0.263
		(0.236)			(0.224)	(0.215)		(0.322)			(0.317)	(0.302)
Average pension (log)		-0.0638			-0.117	-0.150		0.325*			0.270	0.300*
		(0.101)			(0.101)	(0.103)		(0.171)			(0.175)	(0.175)
Market assets (log)			0.0913		0.119	0.104			0.0799		0.123	0.0932
			(0.0789)		(0.108)	(0.105)			(0.0854)		(0.111)	(0.108)
Inflation assumption				0.122***		0.123***						
				(0.0241)		(0.0240)						
Discount rate										0.255***		0.255***
										(0.0590)		(0.0595)
Within R^2 (No actuary FE)	0.000	0.003	0.004	0.034	0.007	0.041	0.000	0.008	0.001	0.034	0.010	0.044
Obs.	4611	4611	4611	4611	4611	4611	4611	4611	4611	4611	4611	4611
Pension plans	219	219	219	219	219	219	219	219	219	219	219	219

Notes: This table replicates the main-table analysis of actuarial assumptions on the connected set only. Columns 1–6 use the discount rate as the dependent variable and columns 7–12 use the inflation assumption as the dependent variable. Panel A reports the within partial R^2 of actuarial firm fixed effects and the increase in within R^2 from including actuarial firm fixed effects. Panel B reports coefficients on controls. All specifications include plan and year fixed effects; standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table E.4: Actuarial firms and required contribution (connected set only)

	Req. Contrib. (% payroll)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Explanatory power of actuarial firm fixed effects						
Partial within R^2	0.049	0.057	0.060	0.049	0.055	0.056
Increase in within R^2	0.049	0.028	0.056	0.049	0.027	0.027
Panel B. Control coefficients						
Active members (log)		-50.08***			-50.56***	-50.74***
		(6.176)			(6.219)	(6.280)
Beneficiaries (log)		0.291			-0.472	-0.359
		(2.103)			(2.242)	(2.171)
Average salary (log)		-8.676			-9.439	-9.324
		(8.587)			(8.092)	(7.754)
Average pension (log)		18.40***			17.52***	16.89***
		(5.155)			(5.742)	(5.746)
Market assets (log)			-20.10***		1.961	2.425
			(6.684)		(4.466)	(4.242)
Discount rate				-4.692		-4.593*
				(4.949)		(2.643)
Within R^2 (No actuary FE)	0.000	0.511	0.067	0.008	0.512	0.519
Obs.	4414	4414	4414	4414	4414	4414
Pension plans	220	220	220	220	220	220

Notes: This table replicates Table D.5 on the connected set only. The dependent variable is the required contribution (employer plus employee) as a percentage of payroll. Panel A reports the within partial R^2 of actuarial firm fixed effects and the increase in within R^2 from including actuarial firm fixed effects. Panel B reports coefficients on controls. All specifications include plan and year fixed effects; standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

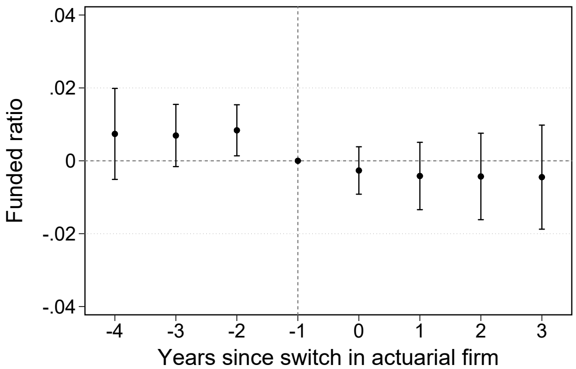
Table E.5: Small actuarial firms and plan financials (connected set only)

	(1) Funded ratio	(2) Act. Liabilities (log)	(3) Act. Assets (log)	(4) Discount rate	(5) Inflation	(6) Req. Contrib. (% payroll)
Small actuarial firm	0.023*	-0.032*	-0.000	0.038	0.064	4.068*
	(0.013)	(0.017)	(0.007)	(0.046)	(0.072)	(2.406)
Active members (log)	-0.066***	0.147***	0.028***	-0.018	-0.056	-50.740***
	(0.013)	(0.016)	(0.009)	(0.078)	(0.054)	(6.290)
Beneficiaries (log)	-0.220***	0.332***	0.031**	0.017	-0.132	-0.999
	(0.027)	(0.033)	(0.014)	(0.062)	(0.091)	(2.410)
Average salary (log)	-0.240***	0.425***	0.047	-0.025	0.148	-6.741
	(0.046)	(0.070)	(0.035)	(0.215)	(0.298)	(8.309)
Average pension (log)	-0.146***	0.306***	0.050**	-0.127	0.261	19.103***
	(0.033)	(0.054)	(0.022)	(0.099)	(0.175)	(5.370)
Market assets (log)	0.386***	0.238***	0.908***	0.091	0.126	2.667
	(0.025)	(0.046)	(0.019)	(0.108)	(0.114)	(4.853)
Year FE	✓	✓	✓	✓	✓	✓
Plan FE	✓	✓	✓	✓	✓	✓
Plans	220	220	220	220	219	220
Observations	4667	4667	4667	4667	4611	4414

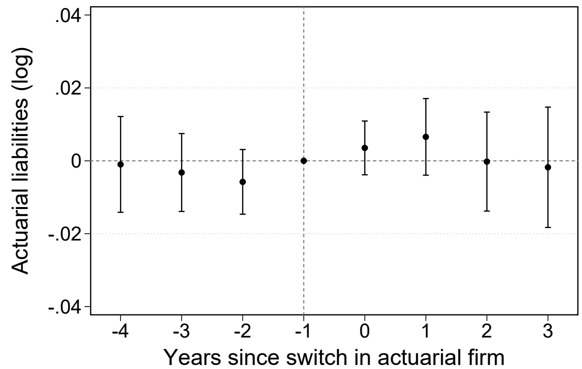
Notes: This table replicates the small-actuary regression table on the connected set only. Each column reports a separate regression of the indicated outcome on an indicator for small actuarial firms and plan fundamentals, with plan and year fixed effects. The estimation sample is held fixed across columns by requiring non-missing outcomes and covariates for the most restrictive specification. Standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Figure E.1: Switching event study (connected set only)

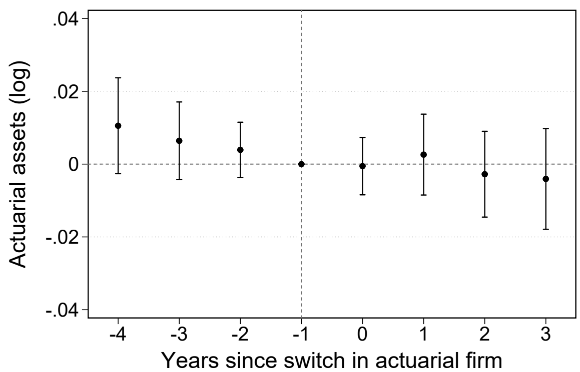
(a) Funded ratio



(b) Actuarial liabilities



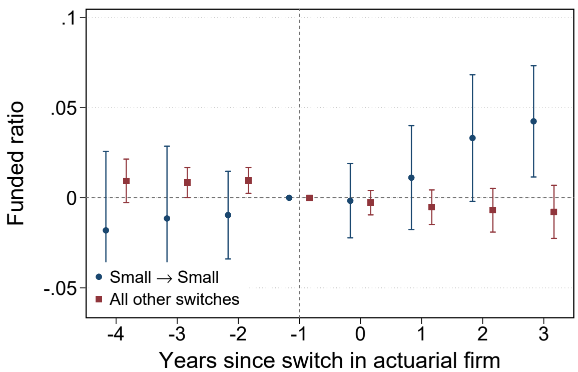
(c) Actuarial assets



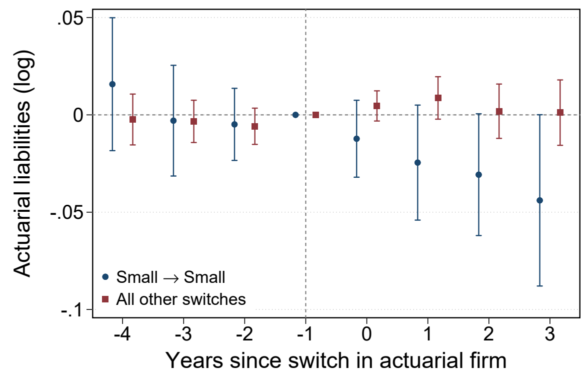
Notes: This figure replicates Figure 6 on the connected set only. Each panel plots stacked difference-in-differences event-study coefficients around the year in which a pension plan switches actuarial firm. Coefficients are estimated with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Coefficients are normalized to zero in the year immediately before the switch. Vertical bars represent 95% confidence intervals.

Figure E.2: Switching event study – heterogeneity (connected set only)

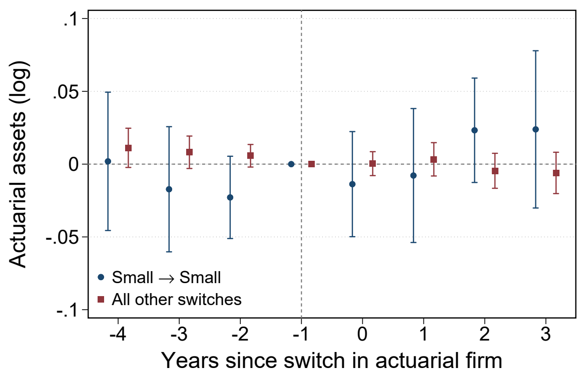
(a) Funded ratio



(b) Actuarial liabilities



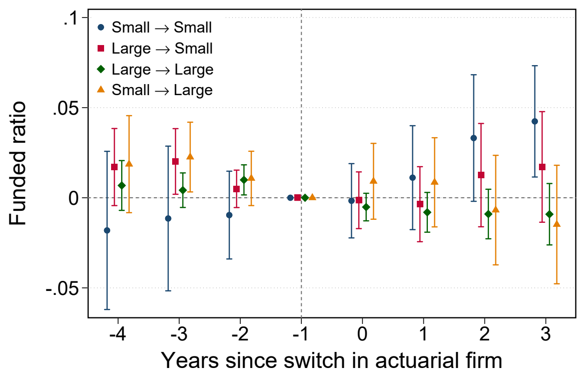
(c) Actuarial assets



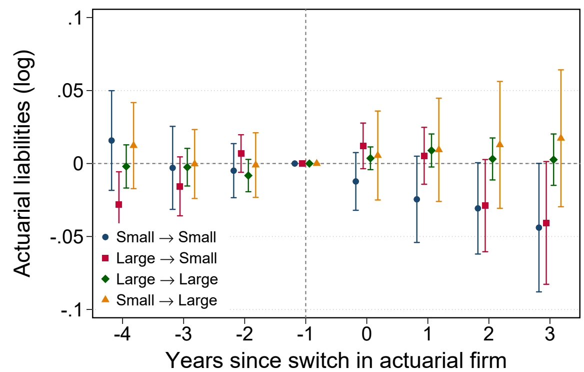
Notes: This figure replicates the heterogeneity panels of Figure 6 on the connected set only. Each panel plots stacked difference-in-differences event-study coefficients separately for switches between small actuarial firms (blue) versus all other switches (red). Coefficients are estimated with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Vertical bars represent 95% confidence intervals.

Figure E.3: Switching event study – four switch types (connected set only)

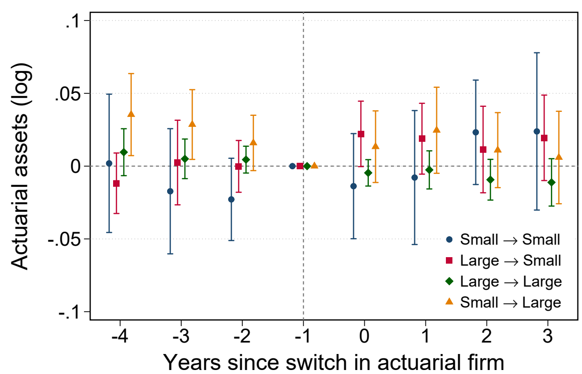
(a) Funded ratio



(b) Actuarial liabilities



(c) Actuarial assets



Notes: This figure replicates Figure C.1 on the connected set only. Each panel plots stacked difference-in-differences event-study coefficients by type of switch. Coefficients are estimated with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Blue (Small → Small) denotes switches between small actuarial firms, red (Large → Small) denotes switches from a large to a small firm, green (Large → Large) denotes switches between large firms, and orange (Small → Large) denotes switches from a small to a large firm. Vertical bars represent 95% confidence intervals.

F. Excluding plans with carried-forward actuarial values

Some pension plans in the sample conduct biennial rather than annual actuarial valuations. For off-years in which no valuation is performed, the data carry forward the most recent actuarial values (funded ratio, liabilities, assets, discount rate). In total, 22 of 234 plans (9.4%) have at least one carried-forward observation: 11 plans follow a systematic biennial valuation schedule and 11 plans have a single isolated gap. To verify that these carried-forward values do not drive the main results, this appendix re-estimates all main analyses after dropping these 22 plans entirely. The connected set, actuarial firm fixed effects, and stacked event-study datasets are reconstructed from scratch on the restricted sample. The results are very similar to the baseline, confirming that carried-forward actuarial values are not driving the findings.

Table F.1: Actuarial firms and funded ratios (excluding carried-forward plans)

	Funded ratio					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Explanatory power of actuarial firm fixed effects						
Partial within R^2	0.064	0.064	0.064	0.059	0.057	0.052
Increase in within R^2	0.064	0.062	0.056	0.057	0.031	0.027
Panel B. Control coefficients						
Active members (log)		0.0110			-0.0706***	-0.0683***
		(0.0269)			(0.0124)	(0.0121)
Beneficiaries (log)		-0.0635**			-0.238***	-0.237***
		(0.0304)			(0.0268)	(0.0264)
Average salary (log)		-0.0994			-0.208***	-0.211***
		(0.0756)			(0.0454)	(0.0444)
Average pension (log)		0.0278			-0.161***	-0.155***
		(0.0424)			(0.0347)	(0.0342)
Market assets (log)			0.156***		0.419***	0.411***
			(0.0399)		(0.0227)	(0.0207)
Discount rate				0.0634***		0.0482***
				(0.0160)		(0.00866)
Within R^2 (No actuary FE)	0.000	0.031	0.123	0.041	0.453	0.477
Obs.	4460	4460	4460	4460	4460	4460
Pension plans	210	210	210	210	210	210

Notes: This table replicates Table D.2 after dropping all plans that ever had a carried-forward actuarial value. Panel A reports the within partial R^2 of actuarial firm fixed effects and the increase in within R^2 from including actuarial firm fixed effects. Panel B reports coefficients on controls. All specifications include plan and year fixed effects; standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table F.2: Actuarial firms, liabilities, and assets (excluding carried-forward plans)

	Actuarial liabilities						Actuarial assets					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Explanatory power of actuarial firm fixed effects												
Partial within R^2	0.072	0.103	0.081	0.069	0.097	0.085	0.051	0.068	0.027	0.053	0.028	0.029
Increase in within R^2	0.072	0.025	0.035	0.068	0.020	0.016	0.051	0.032	0.003	0.053	0.002	0.003
Panel B. Control coefficients												
Active members (log)		0.184***			0.139***	0.136***		0.205***			0.0310***	0.0319***
		(0.0243)			(0.0162)	(0.0141)		(0.0495)			(0.00892)	(0.00930)
Beneficiaries (log)		0.435***			0.340***	0.338***		0.409***			0.0386**	0.0390**
		(0.0332)			(0.0346)	(0.0326)		(0.0510)			(0.0161)	(0.0157)
Average salary (log)		0.418***			0.358***	0.363***		0.265*			0.0336	0.0324
		(0.0756)			(0.0725)	(0.0716)		(0.141)			(0.0334)	(0.0319)
Average pension (log)		0.414***			0.310***	0.301***		0.458***			0.0557**	0.0581**
		(0.0647)			(0.0569)	(0.0555)		(0.0949)			(0.0249)	(0.0251)
Market assets (log)			0.644***		0.229***	0.242***			0.951***		0.892***	0.889***
			(0.0693)		(0.0525)	(0.0474)			(0.0113)		(0.0216)	(0.0203)
Discount rate				-0.0501*		-0.0745***				0.0694		0.0189**
				(0.0294)		(0.0140)				(0.0468)		(0.00739)
Within R^2 (No actuary FE)	0.000	0.756	0.575	0.010	0.794	0.811	0.000	0.523	0.908	0.007	0.911	0.911
Obs.	4460	4460	4460	4460	4460	4460	4460	4460	4460	4460	4460	4460
Pension plans	210	210	210	210	210	210	210	210	210	210	210	210

Notes: This table replicates Table D.3 after dropping all plans that ever had a carried-forward actuarial value. Columns 1–6 report results for the log of actuarial liabilities and columns 7–12 report results for the log of actuarial assets. Panel A reports the within partial R^2 of actuarial firm fixed effects and the increase in within R^2 from including actuarial firm fixed effects. Panel B reports coefficients on controls. All specifications include plan and year fixed effects; standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table F.3: Actuarial firms and economic assumptions (excluding carried-forward plans)

	Discount rate						Inflation assumption					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Explanatory power of actuarial firm fixed effects												
Partial within R^2	0.075	0.076	0.075	0.070	0.075	0.070	0.079	0.079	0.080	0.075	0.078	0.073
Increase in within R^2	0.075	0.076	0.075	0.067	0.075	0.066	0.079	0.078	0.080	0.071	0.077	0.069
Panel B. Control coefficients												
Active members (log)		-0.0184			-0.0508	-0.0428		-0.0289			-0.0571	-0.0408
		(0.0721)			(0.0743)	(0.0761)		(0.0552)			(0.0525)	(0.0606)
Beneficiaries (log)		0.0510			-0.0183	0.00408		-0.0981			-0.158*	-0.152*
		(0.0417)			(0.0614)	(0.0592)		(0.0710)			(0.0881)	(0.0855)
Average salary (log)		0.0927			0.0480	0.0115		0.297			0.258	0.243
		(0.214)			(0.201)	(0.192)		(0.303)			(0.295)	(0.280)
Average pension (log)		-0.0599			-0.135	-0.178*		0.373**			0.308*	0.351*
		(0.105)			(0.105)	(0.107)		(0.177)			(0.180)	(0.181)
Market assets (log)			0.101		0.167	0.147			0.0680		0.145	0.0915
			(0.0829)		(0.111)	(0.109)			(0.0888)		(0.117)	(0.117)
Inflation assumption				0.141***		0.141***						
				(0.0244)		(0.0246)						
Discount rate										0.320***		0.319***
										(0.0638)		(0.0649)
Within R^2 (No actuary FE)	0.000	0.002	0.006	0.050	0.009	0.059	0.000	0.011	0.001	0.050	0.014	0.064
Obs.	4399	4399	4399	4399	4399	4399	4399	4399	4399	4399	4399	4399
Pension plans	210	210	210	210	210	210	210	210	210	210	210	210

Notes: This table replicates the main-table analysis of actuarial assumptions after dropping all plans that ever had a carried-forward actuarial value. Columns 1–6 use the discount rate as the dependent variable and columns 7–12 use the inflation assumption as the dependent variable. Panel A reports the within partial R^2 of actuarial firm fixed effects and the increase in within R^2 from including actuarial firm fixed effects. Panel B reports coefficients on controls. All specifications include plan and year fixed effects; standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table F.4: Small actuarial firms and plan financials (excluding carried-forward plans)

	(1) Funded ratio	(2) Actuarial Liabilities (log)	(3) Actuarial Assets (log)	(4) Discount rate	(5) Inflation assumption	(6) Req. Contrib. (% payroll)
Small actuarial firm	0.029**	-0.030*	-0.005	0.036	0.059	1.315
	(0.013)	(0.017)	(0.007)	(0.047)	(0.077)	(1.552)
Active members (log)	-0.072***	0.139***	0.030***	-0.034	-0.059	-50.006***
	(0.012)	(0.016)	(0.009)	(0.077)	(0.053)	(6.325)
Beneficiaries (log)	-0.241***	0.342***	0.036**	-0.031	-0.194**	1.010
	(0.027)	(0.037)	(0.016)	(0.066)	(0.098)	(2.250)
Average salary (log)	-0.211***	0.375***	0.032	0.004	0.181	-17.926
	(0.046)	(0.073)	(0.034)	(0.188)	(0.276)	(12.011)
Average pension (log)	-0.156***	0.307***	0.058**	-0.136	0.301*	21.763***
	(0.034)	(0.056)	(0.024)	(0.103)	(0.179)	(5.565)
Market assets (log)	0.417***	0.241***	0.898***	0.160	0.164	-1.518
	(0.023)	(0.051)	(0.021)	(0.112)	(0.120)	(4.596)
Year FE	✓	✓	✓	✓	✓	✓
Plan FE	✓	✓	✓	✓	✓	✓
Plans	210	210	210	210	210	210
Observations	4460	4460	4460	4460	4399	4207

Notes: This table replicates the small-actuary regression table after dropping all plans that ever had a carried-forward actuarial value. Each column reports a separate regression of the indicated outcome on an indicator for small actuarial firms and plan fundamentals, with plan and year fixed effects. The estimation sample is held fixed across columns by requiring non-missing outcomes and covariates for the most restrictive specification. Standard errors are clustered at the plan level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

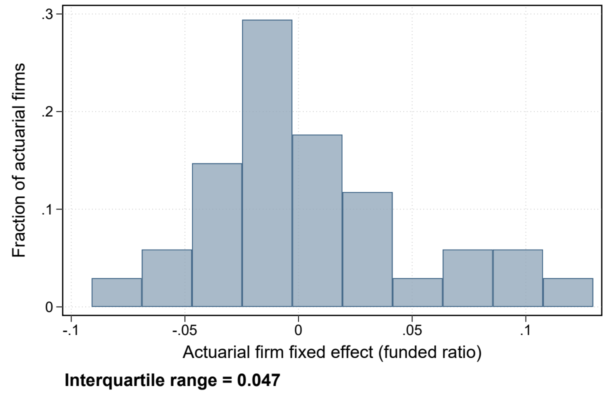
Table F.5: Variance decomposition (excluding carried-forward plans)

	Funded Ratio		Act. Liabilities		Act. Assets		Discount Rate		Inflation		Req. Contrib.	
	Level	Percent	Level	Percent	Level	Percent	Level	Percent	Level	Percent	Level	Percent
Panel (a): Plug-in on Full Connected Set												
Var(Y)	108.185	100%	0.024	100%	0.004	100%	0.134	100%	0.275	100%	366.225	100%
Plan effects	79.287	73.3%	0.017	71.9%	0.002	53.6%	0.084	62.6%	0.130	47.2%	246.064	67.2%
Actuarial firm effects	16.802	15.5%	0.001	4.6%	0.001	26.6%	0.020	14.6%	0.079	28.6%	13.909	3.8%
2 × Cov(Plan, Firm)	-28.680	-26.5%	-0.002	-7.8%	-0.002	-47.7%	-0.030	-22.1%	-0.065	-23.8%	-35.047	-9.6%
Residual	40.775	37.7%	0.007	31.3%	0.003	67.5%	0.060	44.9%	0.132	48.0%	141.298	38.6%
Observations	4,280		4,280		4,280		4,280		4,238		4,050	
Plans	200		200		200		200		200		200	
Actuarial firms	34		34		34		34		34		34	
Panel (b): Plug-in on Leave-One-Out Connected Set												
Var(Y)	91.843	100%	0.019	100%	0.004	100%	0.136	100%	0.272	100%	222.069	100%
Plan effects	55.749	60.7%	0.013	68.6%	0.002	36.7%	0.076	55.4%	0.121	44.7%	123.256	55.5%
Actuarial firm effects	5.180	5.6%	0.001	4.4%	0.000	3.0%	0.010	7.1%	0.032	11.9%	5.281	2.4%
2 × Cov(Plan, Firm)	-5.058	-5.5%	-0.001	-5.2%	-0.000	-4.4%	-0.011	-7.8%	-0.019	-7.0%	-2.178	-1.0%
Residual	35.972	39.2%	0.006	32.1%	0.003	64.7%	0.062	45.3%	0.137	50.3%	95.710	43.1%
Observations	3,823		3,823		3,823		3,823		3,696		3,638	
Plans	182		182		182		182		178		182	
Actuarial firms	25		25		25		25		22		24	
Panel (c): KSS (Bias-corrected) on Leave-One-Out Connected Set												
Var(Y)	91.843	100%	0.019	100%	0.004	100%	0.136	100%	0.272	100%	222.069	100%
Plan effects	53.866	58.7%	0.013	66.1%	0.001	33.0%	0.062	45.7%	0.100	36.7%	117.575	52.9%
Actuarial firm effects	4.383	4.8%	0.001	3.6%	0.000	1.5%	0.009	6.5%	0.030	11.1%	4.276	1.9%
2 × Cov(Plan, Firm)	-4.164	-4.5%	-0.001	-4.1%	-0.000	-2.3%	-0.010	-7.1%	-0.016	-5.9%	-1.000	-0.5%
Residual	37.758	41.1%	0.007	34.5%	0.003	67.7%	0.075	54.9%	0.158	58.1%	101.217	45.6%
Observations	3,823		3,823		3,823		3,823		3,696		3,638	
Plans	182		182		182		182		178		182	
Actuarial firms	25		25		25		25		22		24	

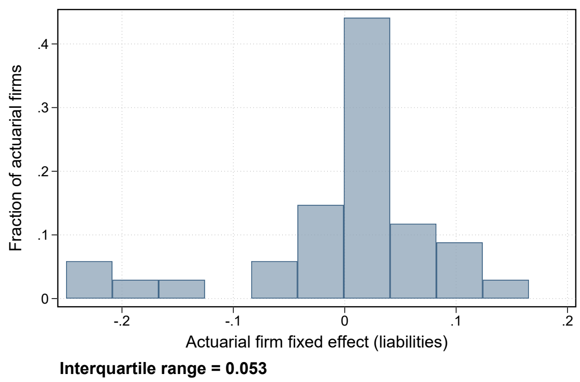
Notes: This table replicates Table 3 after dropping all plans that ever had a carried-forward actuarial value. The connected set is reconstructed from scratch on the restricted sample. Outcomes are first residualized on plan size controls and log assets. Panel (a) reports naive plug-in estimates on the full connected set. Panel (b) reports naive plug-in estimates on the leave-one-out connected set. Panel (c) reports KSS bias-corrected estimates. Shares may not sum to 100% due to residual variance.

Figure F.1: Distribution of actuarial firm fixed effects (excluding carried-forward plans)

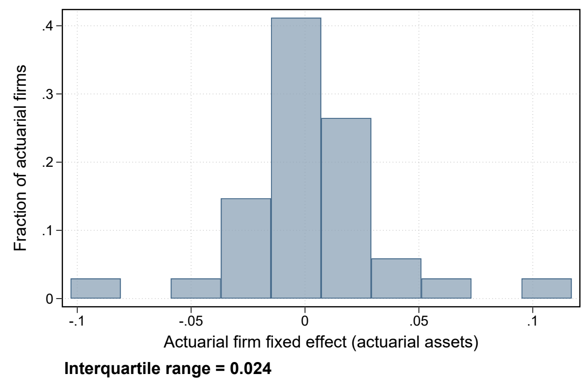
(a) Funded ratio



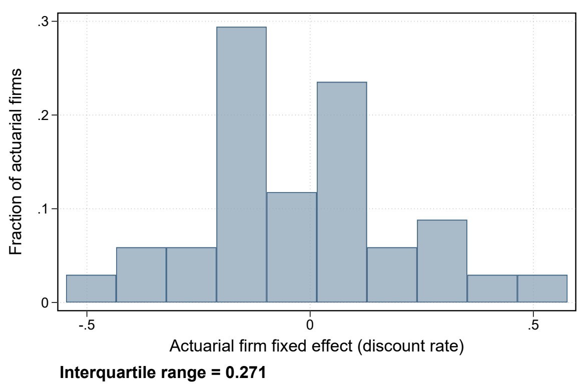
(b) Actuarial liabilities



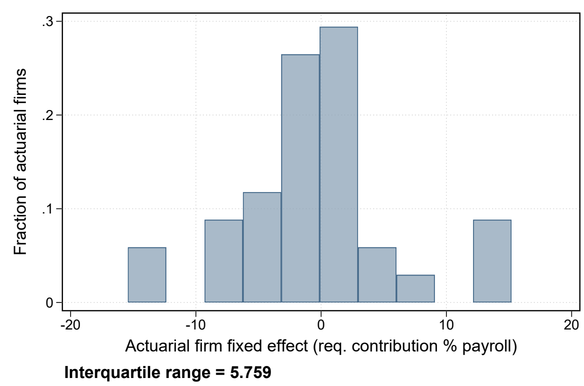
(c) Actuarial assets



(d) Discount rate



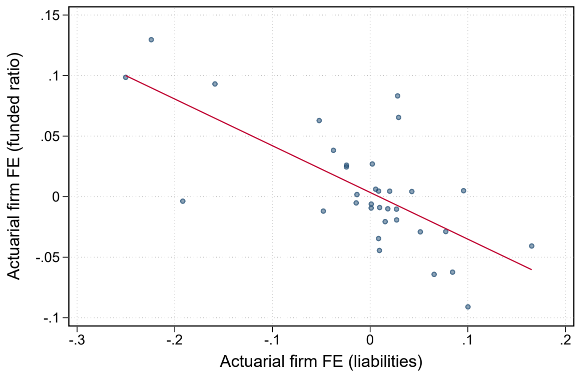
(e) Required contribution (% of payroll)



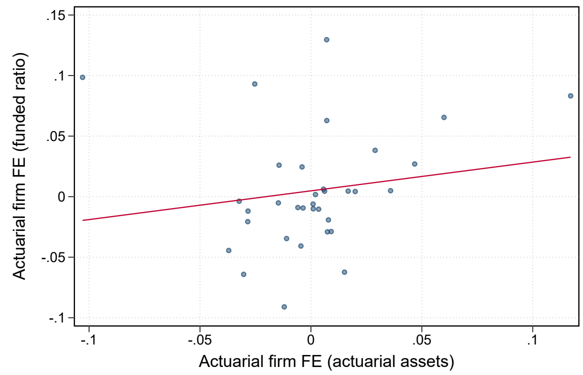
Notes: This figure replicates Figure 4 after dropping all plans that ever had a carried-forward actuarial value. The connected set and actuarial firm fixed effects are re-estimated from scratch on the restricted sample. Each panel plots the distribution of actuarial firm fixed effects from AKM-style regressions that control for plan fixed effects, year fixed effects, and plan fundamentals. Firm effects are recentered so that their mean is zero. The vertical axis reports the fraction of actuarial firms in each bin.

Figure F.2: Relationship between actuarial firm fixed effects across outcomes (excluding carried-forward plans)

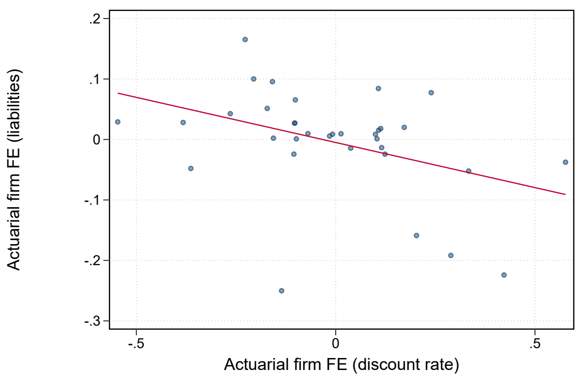
(a) Funded ratio vs. liabilities



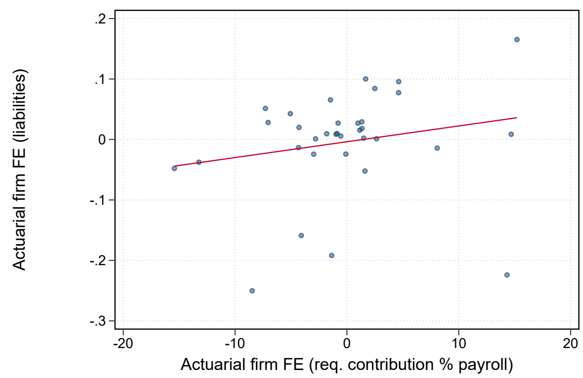
(b) Funded ratio vs. actuarial assets



(c) Liabilities vs. discount rate



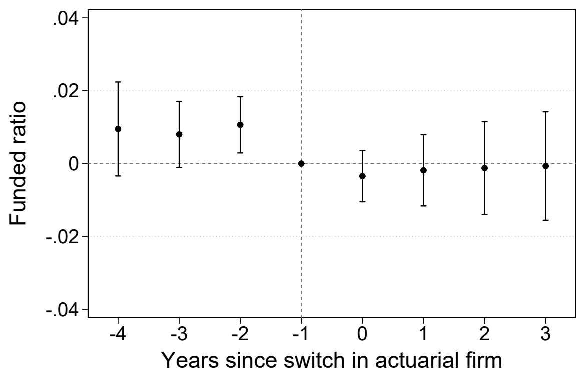
(d) Liabilities vs. required contribution



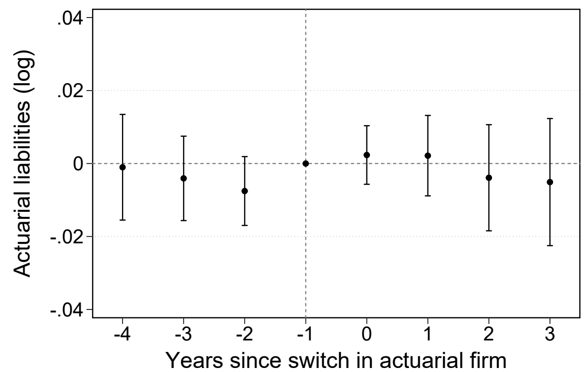
Notes: This figure replicates Figure 5 after dropping all plans that ever had a carried-forward actuarial value. The connected set and actuarial firm fixed effects are re-estimated from scratch on the restricted sample. Each panel plots an actuarial firm-level scatterplot of shrunken fixed effects. Points correspond to actuarial firms. The fitted line is the OLS best linear fit.

Figure F.3: Switching event study (excluding carried-forward plans)

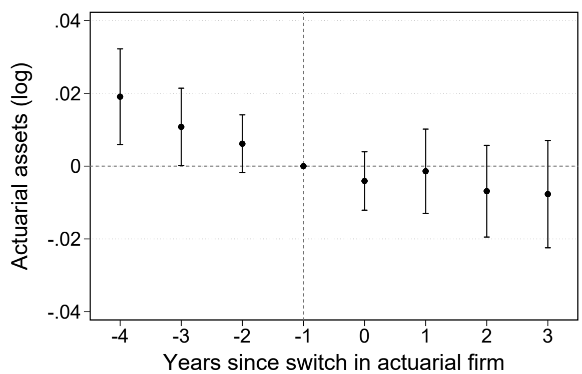
(a) Funded ratio



(b) Actuarial liabilities



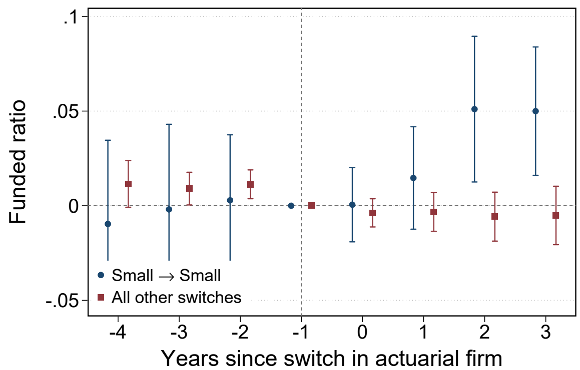
(c) Actuarial assets



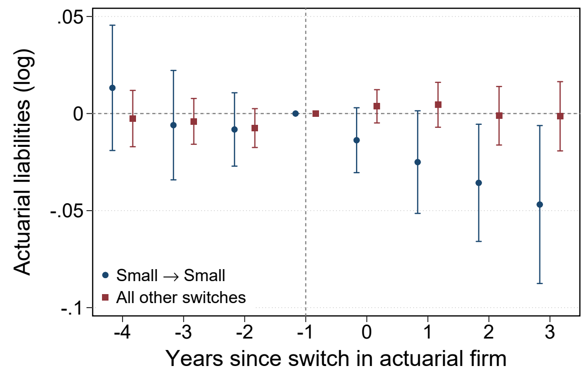
Notes: This figure replicates Figure 6 after dropping all plans that ever had a carried-forward actuarial value. The connected set and stacked event-study datasets are reconstructed from scratch on the restricted sample. Each panel plots stacked difference-in-differences event-study coefficients around the year in which a pension plan switches actuarial firm. Coefficients are estimated with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Coefficients are normalized to zero in the year immediately before the switch. Vertical bars represent 95% confidence intervals.

Figure F.4: Switching event study – heterogeneity (excluding carried-forward plans)

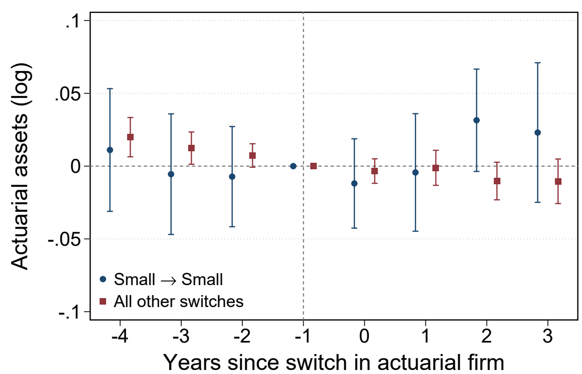
(a) Funded ratio



(b) Actuarial liabilities



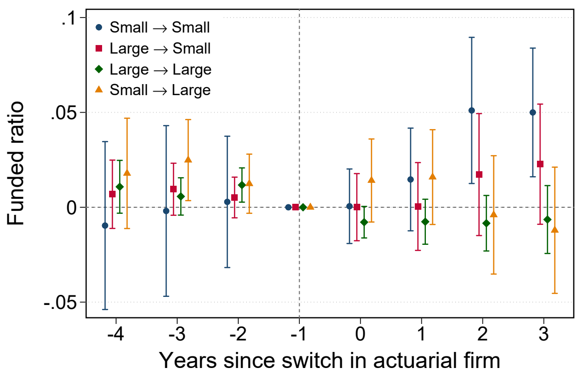
(c) Actuarial assets



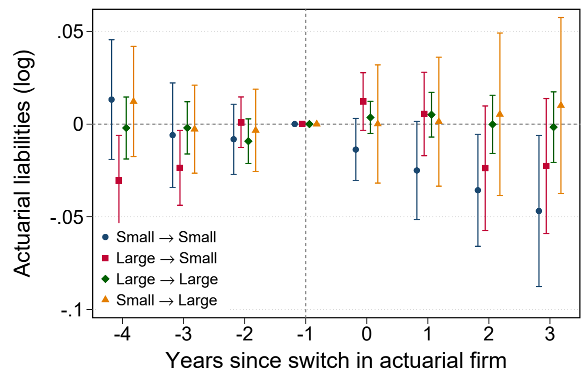
Notes: This figure replicates the heterogeneity panels of Figure 6 after dropping all plans that ever had a carried-forward actuarial value. The connected set and stacked event-study datasets are reconstructed from scratch on the restricted sample. Each panel plots stacked difference-in-differences event-study coefficients separately for switches between small actuarial firms (blue) versus all other switches (red). Coefficients are estimated with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Vertical bars represent 95% confidence intervals.

Figure F.5: Switching event study – four switch types (excluding carried-forward plans)

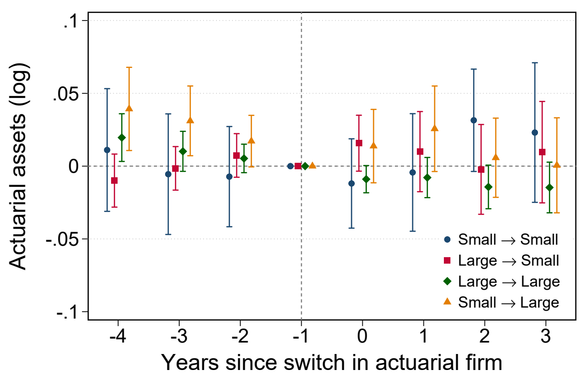
(a) Funded ratio



(b) Actuarial liabilities



(c) Actuarial assets



Notes: This figure replicates Figure C.1 after dropping all plans that ever had a carried-forward actuarial value. The connected set and stacked event-study datasets are reconstructed from scratch on the restricted sample. Each panel plots stacked difference-in-differences event-study coefficients by type of switch. Coefficients are estimated with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. The control group consists of plans that never switch actuarial firm. Blue (Small → Small) denotes switches between small actuarial firms, red (Large → Small) denotes switches from a large to a small firm, green (Large → Large) denotes switches between large firms, and orange (Small → Large) denotes switches from a small to a large firm. Vertical bars represent 95% confidence intervals.

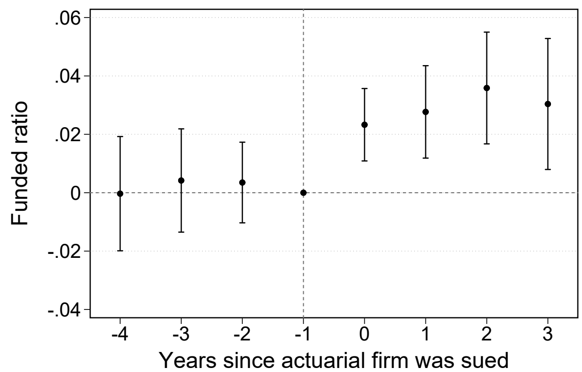
G. Lawsuit event study robustness

G.1 Excluding plans with carried-forward actuarial values

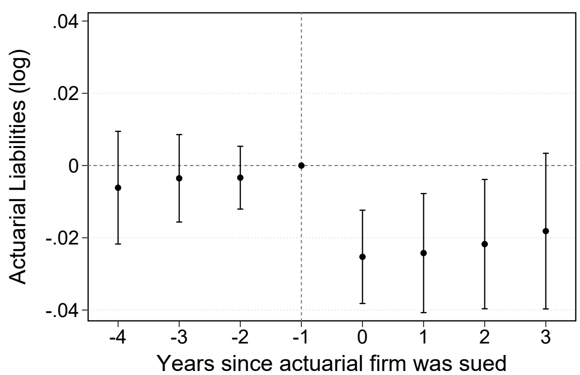
Figure G.1 replicates the lawsuit event study after dropping all plans that ever had a carried-forward actuarial value. The results are very similar to the baseline, confirming that carried-forward observations are not driving the lawsuit findings.

Figure G.1: Lawsuit event study (excluding carried-forward plans)

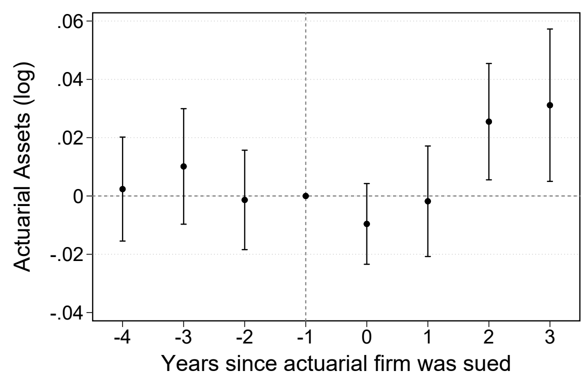
(a) Funded ratio



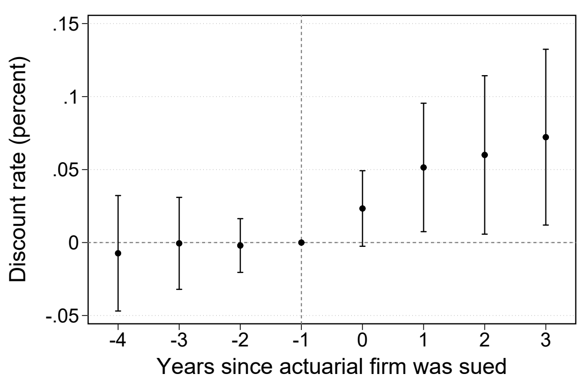
(b) Actuarial liabilities



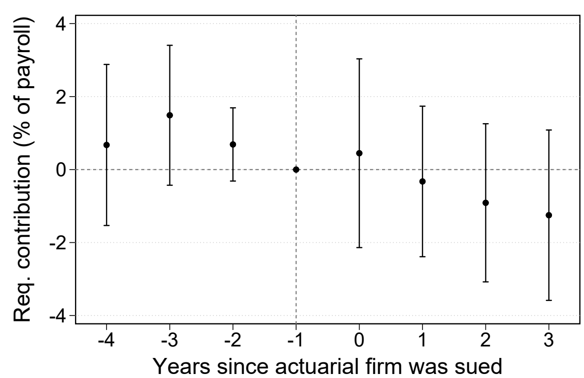
(c) Actuarial assets



(d) Discount rate



(e) Required contribution (% of payroll)



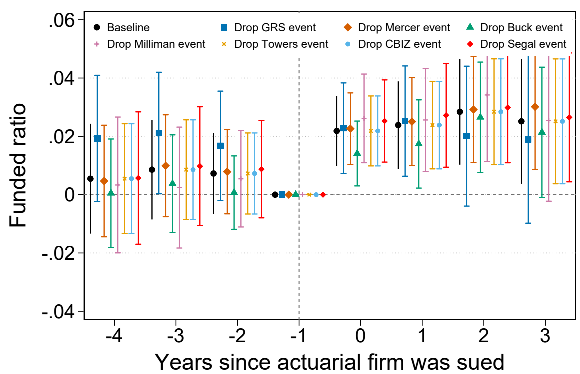
Notes: This figure replicates Figure 7 after dropping all plans that ever had a carried-forward actuarial value. Each panel plots stacked difference-in-differences event-study coefficients around the year in which an actuarial firm is sued for actuarial malpractice. The treated sample consists of pension plans that employ the sued actuarial firm in the year of the lawsuit. The control group consists of plans whose actuary was never sued while they were a client. Coefficients are estimated from equation (3) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. Vertical bars represent 95% confidence intervals.

G.2 Leave-one-out estimates

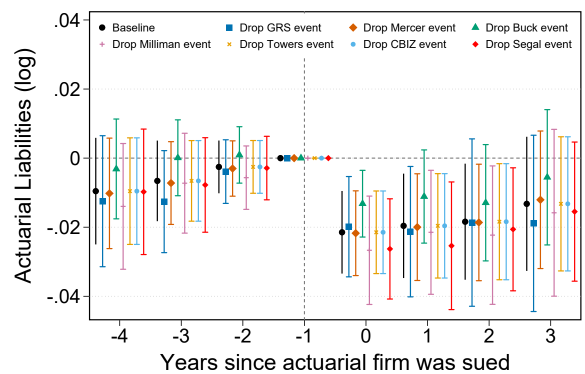
To assess whether the lawsuit event-study results are driven by any single case, I re-estimate the stacked specification dropping one lawsuit cohort at a time. The patterns are stable across all specifications, indicating that no individual lawsuit is driving the findings.

Figure G.2: Lawsuit event study – leave-one-out robustness (financials)

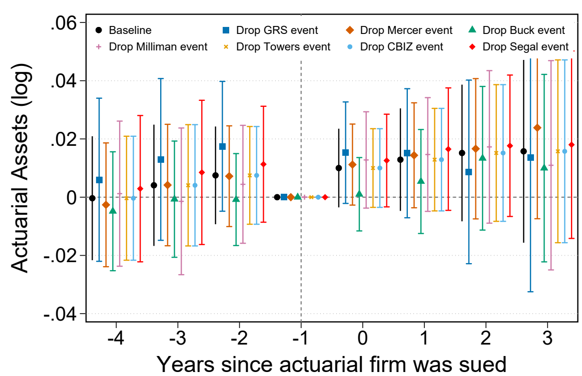
(a) Funded ratio



(b) Actuarial liabilities



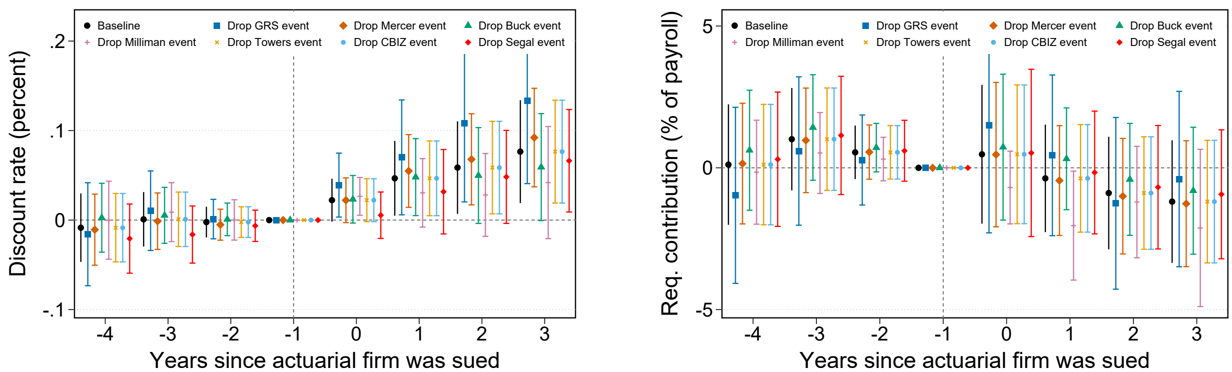
(c) Actuarial assets



Notes: Each panel plots stacked difference-in-differences event-study coefficients from the baseline lawsuit specification together with leave-one-out estimates obtained by dropping each lawsuit cohort in turn. Coefficients are estimated from equation (3) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls.

Figure G.3: Lawsuit event study – leave-one-out robustness (assumptions and contributions)

(a) Discount rate **(b)** Required contribution (% of payroll)



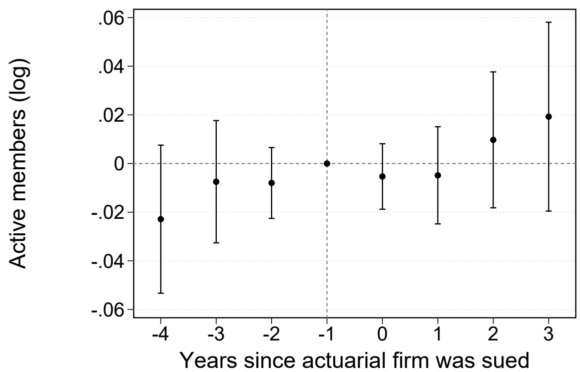
Notes: Each panel plots stacked difference-in-differences event-study coefficients from the baseline lawsuit specification together with leave-one-out estimates obtained by dropping each lawsuit cohort in turn. Coefficients are estimated from equation (3) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls.

G.3 Placebo outcomes

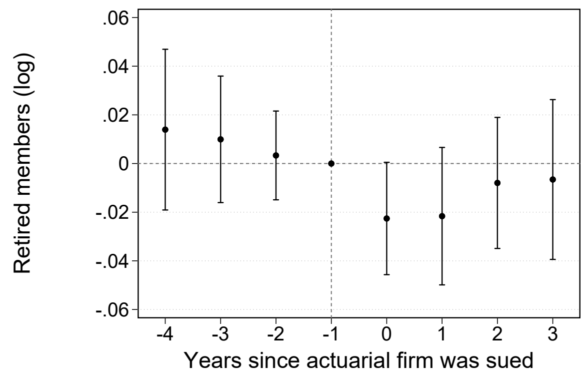
As a placebo check, I re-estimate the lawsuit event study using plan fundamentals—active members, beneficiaries, average salary, and average pension—as outcomes. These variables reflect underlying plan demographics and should not be directly affected by actuarial discretion or reporting choices. If the lawsuit results were driven by coincidental changes in plan characteristics rather than actuarial behavior, we would expect similar post-lawsuit dynamics in these fundamentals. Figure G.4 shows that the placebo outcomes are flat throughout the event window, with no systematic pre- or post-lawsuit movements.

Figure G.4: Lawsuit event study – placebo outcomes

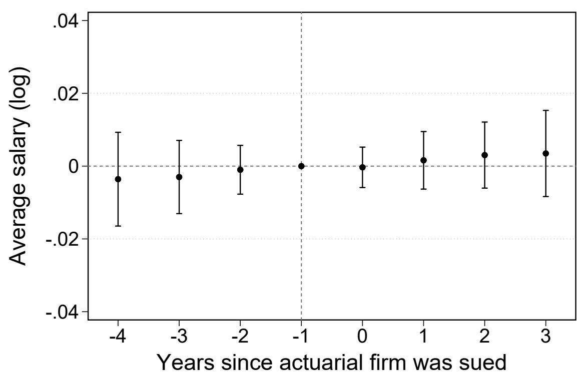
(a) Log active members



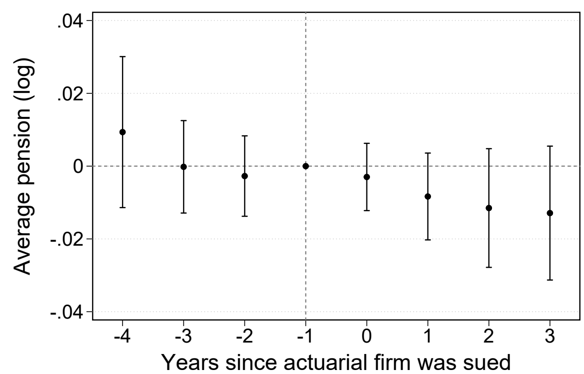
(b) Log beneficiaries



(c) Log average salary



(d) Log average pension



Notes: Each panel plots stacked difference-in-differences event-study coefficients using plan fundamentals as dependent variables. The treated sample consists of pension plans that employ the sued actuarial firm in the year of the lawsuit. The control group consists of plans whose actuary was never sued while they were a client. Coefficients are estimated from equation (3) with cohort-by-plan and cohort-by-year fixed effects and plan fundamentals as controls. Vertical bars represent 95% confidence intervals. These variables should not be affected by actuarial discretion; the absence of systematic movements supports the interpretation that the main lawsuit results reflect changes in reporting rather than in underlying plan characteristics.

H. Manual corrections to PPD data

The Public Plans Database provides a harmonized panel, but the raw data contain missing values, data-entry errors, unit inconsistencies, and field-definition changes that require manual correction. I address these issues through a systematic review of actuarial valuation reports (AVs) and Comprehensive Annual Financial Reports (CAFRs) for plans where anomalies are apparent. In total, manual corrections affect roughly 5–10% of plan–year observations across categories, with actuarial firm identities and assumption fields accounting for the largest shares. This appendix describes the main categories of corrections.

Actuarial firm identities. The PPD leaves the actuarial firm field blank for a number of plan–years, particularly in the early years of the panel and for smaller local plans. In other cases it attributes the valuation to the wrong entity, for example recording the auditing firm instead of the actuary, or carrying forward a predecessor firm's name past a transition date. I fill missing entries and correct misattributions by consulting the certification letters and professional-services pages in the corresponding AVs and CAFRs. I also harmonize spelling variants and abbreviations to canonical names (e.g., "Milliman USA" to "Milliman") and consolidate corporate rebrandings when the same actuaries continue to serve the same clients under a new legal name (e.g., Conduent and Mellon are coded as "Buck Consultants").

Actuarial assumptions. The PPD's expected-return and inflation-assumption fields are missing for many plan–years in the early 2000s. In a few cases the recorded assumption is incorrect, for example due to a decimal-place error or because the PPD reports salary-growth rates rather than the price-inflation assumption used in the valuation. I fill missing values and correct errors using the assumption disclosures in AVs and CAFRs. For plans that changed assumptions on a known schedule (e.g., phased reductions in the discount rate), I verify each year's assumption against the valuation report.

Actuarial liabilities, assets, and funded ratios. Some plan–years have missing or clearly erroneous actuarial values. Common issues include unit or scale errors (e.g., assets reported in dollars rather than thousands), values carried forward from a prior year when an updated valuation exists, and omitted observations for plans with biennial valuation cycles. I replace erroneous values with figures from the corresponding AV or CAFR and, where possible, cross-check by recomputing the funded ratio from corrected assets and liabilities. For plans that conduct biennial valuations, I carry forward the most recent valuation's actuarial outputs in off-years, consistent with standard practice in public pension reporting.

Membership and payroll. Active-member counts, beneficiary counts, and payroll figures are occasionally missing or subject to definition changes. A recurring issue is the redefinition of "covered payroll" under GASB Statement No. 82, which broadened the measure to include employees outside the defined-benefit plan for some systems; where this produces a visible discontinuity, I substitute the DB-member-only payroll series from the valuation report. Other corrections include fixing digit-drop errors in average-salary fields, filling missing beneficiary counts from CAFR schedules, and interpolating membership in off-years for plans with biennial valuations.

Contributions and benefits. Employer and employee contribution fields are occasionally swapped in the PPD, with the employer contribution recorded as the employee contribution and vice versa. I detect these swaps by comparing the reported ratio of employer to employee contributions against the plan's statutory contribution structure and correct them using CAFR financial statements. A small number of plan–years also have missing or anomalous benefits-paid figures, which I fill or correct from CAFR data.